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EFFECT OF ENTRAPPED AIR ON THE ACTION OF WET PIPE ALARM VALVES

DEPARTMENT OF FIRE
PROTECTION ENGINEERING
ARMOUR INSTITUTE OF TECHNOLOGY

EFFECT OF ENTRAPPED AIR ON THE ACTION OF
WET PIPE ALARM VALVES.

A THESIS

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EFFECT OF ENTRAPPED AIR ON THE ACTION OF
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This thesis is an account of a number of tests made at the Underwriters' Laboratories and on sprinkler installations in this city, having for their object an investigation of the action of alarm valves and the effect on them of the entrapped air, with a view to deciding what conditions an acceptable alarm valve must be able to meet.

The work done comprised a series of tests at the Laboratories on the Grinnell and Evans alarm valves using various air cushions, an investigation of sprinkler installations in order to find out what air cushions are to be met with in the field, and a discussion of the conditions which may affect or alter the effect of the entrapped air with suggestions for conducting tests of alarm valves.

The work was done by the four members of the class under the direction of Prof. Fitzhugh Taylor, who has at all times shown a lively interest in the work and whose advice and aid have been invaluable. The investigations carried on in the field were done with the consent of the Chicago Board of Underwriters and we desire to express our indebtedness to Messrs. Glidden and Rice for their aid in securing the necessary permission and information, and to Mr. Brumbaugh who, as representative of the Board, rendered us great service by his knowledge of the systems; also to the firms which permitted their systems to be used for test.

INTRODUCTION.

The chaotic state of the alarm valve situation has been due, in part, to the inability of the Laboratories to issue requirements, or to conduct tests which would show with any finality whether or not a valve would behave reliably in the field. This inability has been caused by a lack of knowledge regarding the conditions which an acceptable alarm valve must fulfil, and the items affecting its action.

It was known that the effect of air entrapped in the system was the principal cause of trouble, and to investigate and demonstrate this effect a series of tests was made on the Grinnell and Evans alarm valves, using various air cushions.

In a sprinkler system, air is entrapped in varying quantities at different levels, and since on this account it is impossible to express the air cushion in terms of pressure and volume of air, Prof. Taylor devised a scheme for expressing an air cushion by its effect: the number of gallons of water passing the alarm check while the service pressure is raised from 60# to 120# he called the "flexibility of the system." Using this method of measurement, an attempt was made to discover the relation, if any, between service pressure, flexibility, and sensitiveness, the sensitiveness being the smallest flow from the system which will operate the alarm.

PART I.

Laboratory Tests of Grinnell and Evans Alarm Valves.

METHOD. The first step in the testing of the Grinnell and Evans valves was to devise some means for obtaining and reproducing air cushions of any desired flexibility. For this purpose the standpipe was filled with water by bleeding off the air through the drain pipe, so as to reduce its flexibility to a known valve (0), and the air cushion varied entirely by means of the 600 gal. calibrated tank on the first floor. The tank was re-calibrated, a curve being plotted with gallons flexibility against gallons of air in the tank at 75#. Curve I. The points on this curve were obtained thus: with the pressure at the main gauge 60#, the volume of air in the tank was read; the pressure was raised to 75# and volume read again; the pressure was raised to 100# and the volume read once more. The volume of air at 75# is the abscissa, and the difference between the volumes at 60# and 100#, - the flexibility - the ordinate of the point.

The first test consisted of a single run, wherein the relation between flexibility and sensitiveness at a given service pressure - 75# - was sought. Curve II. is a graphical representation of the results.

The second set of tests was to show the relation of service pressure to sensitiveness when the flexibility remains constant. Runs were made with flexibilities of 40 gal., 75 gal., and 100 gal. The results are shown by Curves IV., V., and VI, respectively. The exact conditions of each test are noted on the curve sheets.

The rate at which water was drained from the system was measured by means of calibrated nozzles and pressure - delivery curves.

The work on the International alarm valve was limited to one run in which a curve was plotted between sensitiveness and flexibility with service pressure constant. Curve 3.

RESULTS The curves and data of these tests show the following points in connection with the Grinnell Valve:

The sensitiveness of the valve varies widely under different conditions of air cushion. See Curve II. With 75# service pressure and any air cushion with a flexibility in excess of 120 gal., an infinitesimal leak will send in an electrical alarm. With the flexibility between 0 and 120 gal. the sensitiveness rises from 1 to 16 gal. per minute, and falls again to 0.

The sensitiveness of the valve is seriously affected by minor changes in the test conditions. Such changes may be an alteration in the length and size of the water motor connection, a change in the clapper, a change in the spring or diaphragm of the electric circuit closer, or any slight obstruction of the drain from the retarding chamber. Curves IV. and V. Under certain conditions no alarm was obtained with discharges of 50 gal./min.

The work on the International valve, though brief, was sufficient to show that at 75# service pressure with the flexibility of the system between 100 gal. and 250 gal. the sensitiveness is practically constant at 2.5 gal., increasing slightly with the larger air cushions.

The reliability of the alarm mechanism is much greater in the International alarm valve than in the Grinnell; In the Grinnell valve the alarms are operated by the fluctuating pressure in the retarding chamber, while in the International valve the operation of the alarm mechanism opens both water motor and circuit closer to the continuous action of full service pressure.

The foregoing tests showed the unreliability of the Grinnell valve when used over even a moderate range of flexibility, but no definite statement could be made as to its acceptability for actual

service, owing to the lack of information concerning flexibilities existing in the field. It was therefore decided to investigate as many installations as possible in the remaining time, and permission to do this was obtained from the Chicago Board of Underwriters by Prof. Taylor.

PART II.

Manner In Which Air Is Entrapped In Sprinkler Systems.

Before proceeding to an account of the investigations carried on in the field, a description will be given of what takes place when water is turned into a sprinkler system. When water is introduced, the piping is full of air at atmospheric pressure, and as the water rises from the valve to the first crossmain it compresses the air ahead of it. As the water level passes the first crossmain it traps most of the air in that crossmain and branches at slightly more than atmospheric pressure. As the water level continues to rise the air ahead of it is compressed, (and likewise the air in the first level) and as it passes the second level traps this crossmain and branches with air at a slightly higher pressure than before. This continues as the water level rises, water being forced into all the submerged crossmains at the same time, though not at the same rate. The air, being in contact with the water, immediately begins to go into solution, the rate and extent of the saturation depending on the pressure, the amount of surface in contact, and the temperature.

If water is drawn from the system the reverse of this action takes place, save for the effect of air losses; this assumption formed the basis for the method of investigating air cushions in the field.

If a difference of pressure exist between the system and the supply, a flow of water will occur to equalize it, the air will be

compressed and water forced into every submerged crossmain. Where alarm valves such as the Grinnell and Evans are used, which operate by the lifting of a check, a difference of pressure will be caused by the differential of this check. The amount of water passing on a snap of the valve in order to effect equalization depends on the amount of this differential, and the compressibility of the air cushion. As the differential of any valve remains practically constant, we can consider the flow of water to vary with the compressibility of the air cushion against which it acts. The quantity of water, expressed in gallons, which must be introduced into a system to equalize a given difference in pressure we call the flexibility. As previously stated the flexibility is measured between 60# and 120#. Later it was found convenient to adopt more restricted limits.

PART III.

Investigation Of Air Cushions In The Field.

In pursuance of the decision to collect flexibility data from the field, a number of sprinklered risks were visited and permission obtained to make the tests.

APPARATUS. The equipment required consisted of gauges, 200# and 30#, with connections and cocks, two calibrated 4 gal. pails, a large funnel, wrenches, trimos, pipe fittings, etc. Each system is fitted with a 2" drain pipe tapped into the system just above the main alarm check, the pipe being fitted with a union between the valve and the floor. At the top of each system equipped with supervisory service a 1/2" test pipe connects the top crossmain and the drain through a globe valve and union.

METHOD. The tests with slight variations, were conducted as follows: The 2" drain pipe was opened at the union, and the upper part bent around to one side so that the pails could be conveniently filled

from it; into the open end of the drain the funnel was inserted. The pressure gauge above the check valve was removed and the test gauges and their connections substituted. If readings were to be taken at the top of the riser, the union in the test pipe was opened and gauges connected by means of a bushing. Lastly, the main gate valve at the base of the riser was closed, the local alarms having been disconnected. The pressure at the base of the riser,-and that at the top, in case top readings were taken - were read and 4 gal. of water, one pail full, drawn out through the drain pipe and dumped into the funnel; pressures were read again simultaneously and another pail full drawn out and emptied. This was continued until the system had been drained. Top readings were taken on signal from the bottom, signalling being done by tapping on the piping with a wrench.

As a rule, two tests were run on each riser; that is, after the riser had been TESTED AS ABOVE IN THE CONDITION IN WHICH IT WAS FOUND — ~~drained of the water found standing in it~~, it was refilled from the pressure tank, and again TESTED ~~drained~~. At the end of each test the system was vented, and the remaining water column measured by reducing the gauge reading to feet head of water.

A vacuum was produced in the first test of nearly every riser, and this was measured, first by attaching a vacuum gauge and later by shifting the needle on the 30# gauge used at the top, and recalibrating it to read as a compound gauge.

CURVES. A complete investigation consisted of two runs, taking both top and bottom readings, and the curves representing them are plotted with pressures at the base of the riser as ordinates, and quantity of water drawn out as abscissae. In addition to these curves, water column curves were plotted when top readings were taken.

The water column for any given pressure at the base of the riser was obtained by subtracting from the bottom pressure the corresponding top pressure (in #/sq.in.) and converting to feet head of water by multiplying by 2.308.

On each curve sheet a sketch is drawn showing riser and the floors by heavy lines; under each floor supplied by the riser a smaller line indicates the crossmain; mezzanine floors are shown by lines which are slightly smaller than the floor lines but longer than the lines representing sprinkler branches.

The form of the flexibility curves is a combination of hyperbolas and a straight line, the hyperbolic characteristic being due to the air pockets, and the straight line effect, to the water column. The effect of the water column is greatest in high systems, especially high systems with small risers. Curves of Systems of low height and large area approximate more nearly the hyperbola. The "steps" in the curves show whether a riser or a crossmain is being drained, the flat portion of a step showing the amount of water drawn out between the unsealing of that crossmain and its final draining.

The water column curve shows that the amount of water drawn out before the level drops below the top crossmain is much greater than the amount drawn out at any subsequent crossmain. The assumption is that while any crossmain is being drained, water is also being drawn from all the submerged cross mains.

PART IV.

Conditions Which An Acceptable Valve Must Meet.

The investigation of actual air cushions in the field, while far from complete, nevertheless gives some idea of the conditions which an alarm valve must meet in practice, and makes possible the carrying on of thorough and reliable tests in the Laboratories. It

was found that systems having a flexibility between 60# and 120# of more than 100 gal. are far from uncommon, and that in systems of exceptional height the flexibilities may greatly exceed this.

For convenience in describing the effect of air cushion in sprinkler systems, a more restricted definition of flexibility has been found desirable, for two systems having the same flexibility between 60# and 120# may differ considerably in other characteristics.

Hereafter, unless stated otherwise, the flexibility will be the number of gallons which must be drawn from the system to lower the pressure at the foot of the riser 10#. As this flexibility differs at every pressure, the pressure at which the flexibility is taken must be stated. For instance, the flexibility of any system at 60# is the number of gallons of water which must be drawn from that system to lower the pressure at the valve to 50#.

We are now able to state definitely what conditions an acceptable alarm valve must fulfil. Considering only flexibilities at 175#, 120#, 85#, and 60#, our results show that at 175# with a system of great height and large riser (Marshall, Field & Co.), a condition of maximum flexibility, the flexibility is 23 gal., with a smaller system, 4 gal. At 120# the flexibility varies from 4 to 18 gal., average about 10 gal., at 85# from 4 to 40 gal., average about 20 gal., at 60# from 12 to 68 gal. average about 35 gal. The data obtained at Marshall Field & Co's is not included in the foregoing, as this system was totally unlike any other investigated; at 120# the flexibility was 108 gal. as against a maximum of 18 gal. elsewhere, at 85#, 128 gal' as against 40 gal., at 60#, 125 gal. as against 68 gal.

While it is very desirable that a valve should be designed

to successfully meet all possible conditions, it may be found necessary to make a special classification of systems which show, or might show, such exceptional characteristics as the example above cited. The fact that the installation of a sprinkler equipment 18 or 20 stories high would in every case be done under the most careful supervision, would remove the danger of the use of ordinary valves for this purpose.

In the light of our present knowledge we feel safe in stating that an acceptable valve must have a sensitiveness of not less than 10 gal/min. when operating against the following flexibilities:

175# - 15 gal.
120# - 25 gal.
[illegible]# - 50 gal.
60# - 75 gal.

The flexibility of a sprinkler system is dependent, apparently, on its size (number of heads), and height, and the tightness of the joints. Of these, the most important factor for the original flexibility is the height, as shown by the curves from Wilson Bros. and Marshall Field & Co. The 4 story installation of A.C. McClurg and Co. with a total of 900 heads showed a flexibility of 63 gal. between 60# and 120#, while Wilson Bros. a 10 story installation with a total of 850 heads showed a corresponding flexibility of 124 gal. Other things being equal, number of heads seems to affect the flexibility in direct ratio.

The fact that at both Wilson Bros and Marshall Field & Co. the air cushions had been undisturbed, whereas at A. C. McClurg & Co. some of the air had probably been drawn off by A.D.T. inspectors ~~in this way~~ may have influenced the above figures to a slight extent. The generality holds good.

The difference between the curves of the first and second

tests of any system shows the effect on the flexibility of air in losses from the system. These air losses may result from leaks at joints or heads, solution of air in the water, or by draining out of air at the test pipe by A.D.T. inspectors. Air losses are not of much importance, since, in general, if a valve be designed to operate successfully in a system of given flexibility, it will continue to give satisfaction with a diminished air cushion.

Changes of pressure are not of such slight importance, for the fact that a valve acts satisfactorily at one pressure is no proof that it is reliable at any other pressure. Curve sheets 4 and 5.

Testing of Alarm Valves.

The apparatus available for reproducing air cushions at the Underwriters' Laboratories consists of a 6" standpipe 70' high and a 600 gal tank. Air cushions with flexibility between 60# and 120# from 0 to 300 gal. can be obtained with the tank alone, and with both tank and standpipe this might be increased to 350 gal. A flexibility curve of the tank with an air cushion of 40 gal. flexibility was obtained, Curve 8, and is a fair approximation of the field curves for this size air cushion. For more accurate work the tank might be still further calibrated so as to reproduce any one of the small portions of a flexibility curve within a 10 gal. range.

It is not in the purpose of this thesis to attempt to outline a method of Laboratory tests but merely to show what conditions exist in the field, and to briefly suggest how they may be duplicated

DATA OF INDIVIDUAL INSTALLATIONS.

SRRINKLER EQUIPMENT OF	HEIGHT.	TESTS MADE.	SIZE OF RISER	DISTRIBUTION	HEADS/FLOOR	AREA/HEAD	TYPE OF INSTALLATION.	WATER SUPPLY	WATER ON SYSTEM	WATER COLUMN.	SUP'VISRY SERVICE.	REMARKS.
CHICAGO MERCHANTILE CO. 106-112 WABASH AVE.	6 & B	FIRST & Second	5"	C.C	100	70□'	INTERNATIONAL, BY KELLOG, MACKAY, CAMERON. 1903.	2 PRESS. TANKS 3,100 gal. 1 GRAV. TANK 20,700.	6 MOS.	1st Test 2'	YES.	
WILSON BROS. 332-38 FIFTH AVE.	10 & B.	FIRST TEST ON NW. AND SW. RISERS. NW	4"	S.C.	75	70□'	SAME	2 PRESS.-3,100 gal.	2 YRS.		No.	Second Tests duplicate of first
		SW	4"	S.C.	70	70□	1902.	2 GRAV.-21,000 gal.	2 YRS.			
MARSHALL FIELD & CO. 63-85 STATE ST.	13, 3B. 2 STORY TANK HOUSE MEZZANINES.	SECOND TEST ON #4	6"	C.C.	80	64□'	"1890" GRINNELL, A BY GEN. FIRE EX. CO. 1901.	8 PRESS.-2000 gal. 4 GRAV. 30,000 gal.	2 HRS.		YES.	FIRST TEST NOT MADE, SECO CARRIED TO 60" ONLY. FEAR OF COLLAPSING HEADS. PENDANT HEADS.
A.G. SPALDING & CO. 147-49 WABASH AVE.	5 & B	FIRST AND SECOND	4" 5" & 4"	C.C.	80		SAME 1907	FROM CARSON, PIRIE, SCOTT & CO.		1st Test 98'	YES.	TWO RISERS FEED FROM ON 6" VALVE BY ABOUT 40' 6" PIPE.
MORRIS, MANN & REILLY. 183-7 FIFTH AVE.	6 & B	FIRST AND SECOND	5"	C.C.	75-88	71□'	PHOENIX, BY PHOENIX FIRE EX. CO. 1907.	1 PRESS. 3,100 gal. 1 GRAV.-13,000 gal.	15 MOS.	1st Test 19'	YES.	
UNDERWRITERS' LABORATORIES. 382 E. OHIO ST.	3 & B	SECOND AND WATER COLUMN.	4"	S.C.	40. 80 ON 1ST.		GRINNEL SYSTEM VARIOUS TYPES OF HEADS.	1 PRESS.-4500 gal.	6 HRS.		No.	
THOMSON & TAYLOR. 66-72 MICHIGAN AVE.	7 & B	COMPLETE	6"	C.C.	PROBABLY 60-80		GRINNEL OLD & NEW, MANUFACTURERS, INTERNATIONAL.	2 PRESS. 3000 gal. 1 GRAV. 12,700 gal.		2nd Test 3¼' 1st Test 2.5	YES.	ONLY MEZZANINES ON 1ST AND 7TH. SUPPLIED. TEST PIPE AT VERY TOP.
A.C. McCLURG & CO. 455-77 E. OHIO ST.	4 & B	WEST. COMPLETE.	6"	C.C.	132	64□'-78□'	GRINNELL, BY GEN. FIRE EX. CO. 1907.	2 PRESS. 3,000 gal. 2 GRAV. 30,000 gal.	8 MOS.	1st Test 10½	YES.	
		EAST. FIRST.	6"	C.C.	180	〃			8 MOS.			
TRUAX, GREEN & CO. 42-46 WABASH AVE.	5 & B AND MEZZANINES.	COMPLETE	6"	S.C.	134 TOT. 937	76□'	GRINNELL NEW PATTERN, BY. GEN. FIRE EX. CO. 1898.	1 PRESS. 3,076 gal. 1 GRAV.-15,700 gal.	2 YRS.	1st Test 15'	YES.	CONSIDERABLE AIR DRAW OFF BY ENGINEER. Gauge 36" below drain
ALBERT PICK & CO. 199-209 E. RANDOLPH	4 & B.	COMPLETE	5" TO 1ST 4" ABOVE	C.C.	60	68□'	PHOENIX, "A 1906" BY PHOENIX FIRE EX. CO. 1906.	2 PRESS. 3,036 gal. 1 GRAV.-25,300 gal.	18 MOS.	1st Test 8'	YES.	

CHICAGO MERCANTILE CO.

EAST RISER. BOTTOM READINGS.

FIRST TEST.

125
119.5
114.5
109
105
101.5
97.5
93
91
88
85
82.5
80.5
78
76
75
73
70.5
70
68
66.5
65
64
63
61.5
61
60
58.5
58
57
56.8
56.4
55
54.8
52
52.5
52
51.2
50
48.5
47.8
47
46
45.2
45
45
44.2
43.8

43
42.7
42.4
42
41.7
41.5
40.8
39.5
38.5
38
37
37
36.7
36
35.5
35
35
35
34.6
33.8
33
32.4
31.8
30.4
29.8
28.5
28
27.7
27.4
27.1
27
26.6
26.4
26
25.6
25
24.2
23.5
22.7
21.8
20.9
20
19.6
19.6
19.4
19.1
19
19

18.8
18.4
17.8
17
16.3
15.5
14.8
13.9
13
12
11.5
11.3
11.2
11
10.9
10.7
10.5
9.4
8.8
8.
7.3
6.6
6.3
6.2
5.8
5.3
4.8
4.2
3.7
3
2.6
2 2
1.7
1.4
1.4
1.3
1.2
1.1
1
.8
.5
.0

SUCTION
WATER COLUMM
2 FEET.

SECOND TEST.

125
121
115.5
110
106
102
98.5
95.5
89
86
83.5
83.5
79.5
77
76
73
71.8
70
69
67.5
66.3
65
64
63
61.8
60.3
59.6
58.5
58
57
56
55
54.5
52.5
52
50.5
49.8
48.5
48
47
47
46.8
46
46
45
45
44.2
43.8
43

42.5
42
41
40
39
38
37.7
37.5
37.3
37.3
37
36.8
35.8
35.2
35
35
34.5
33
32.2
32
32
31
30
29.1
28.7
28.3
28.1
28
27.7
27.5
27.1
27
26.7
26
25.3
24.8
24
23.2
22.2
21.7
20.9
20.2
19.8
19.7
19.4
19.2
19.1
19
18.8

18.4
17.9
17.2
16.5
15.7
14.9
14.3
13.5
12.7
11.8
11.5
11.4
11.2
11
10.8
10.6
10.4
10
9.4
8.6
8.2
7.7
7.1
6.5
6.1
5.9
5.7
5.5
4.8
4.3
3.8
3.3
2.8
2.4
1.7
1.2
1
1
.8
.2
.0

SLIGHT BLOWING.

WILSON BROS. SOUTHWEST RISER.

BOTTOM READINGS.

FIRST TEST.

NO SECOND TEST.

132.5
130
127
124
121.5
118
116
113.5
111.5
108.5
107.5
104.5
102
99.5
98
97
95.5
94
92
91
90
89
87.5
86.5
85
84.5
83.5
83
82
81
80
78.5
78
77
75
74
72.5
72
71.5
70.5
70
69.5
68.5
68
67.5
67.5
67

66
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63.5
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62
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58.5
58.5
58
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56.5
56
55.5
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54
53.5
53
52
51.5
50.5
49.5
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48.5
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47.5
47
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46.5
46
45.5
45
44
43
42.5
41.5
41
40.5
40.5
40
39.5
39.5
39

38
37.5
37
36.5
35
34
33.5
33.5
33
33
33
32.5
32.5
32.5
32.5
32
31.5
30.5
30
28
27
26.3
26.1
26
25.8
25.5
25.4
25.2
25
25
24.5
23.9
23
22.1
21.2
20.3
19.5
19.2
19.2
19
19
18.8
18.7
18.5
18
18
17.6
17

16.2
15.2
14.3
13.4
13
12.8
12.6
12
11.3
10.2
9.2
8
6.8
6.5
6.3
6
4.6
4.5

WILSON BROS. NORTHWEST RISER.

BOTTOM READINGS.

FIRST TEST.

135.5
130
127
122
118
114.5
111
108
105.5
102.5
100
98
95
93
92
90
87.5
86.5
84
82.5
81
80
78.5
78
77
76
75
74
72.5
72
71
70.5
70
68
67.4
66
65
64
62.5
62
61
60
60
60
59
58.5
57
57
56

55
52.5
51
51
50.5
50
49.5
49
48.5
48
47.5
46.5
45
44
43
42.5
42
42
41.5
41.5
41
40.5
40.5
39.5
38
37.5
37
36
35
35
35
34.5
34
33.5
33
32.5
32
31.5
30.5
30
29
28.7
28.5
28.2
28
27.8
27.5
26.5
25.5

24.5
23.7
22.8
22.4
22.2
22
22
21.8
21.5
21.3
20.5
19.2
18
16.5
16.1
15.9
15.7
15.5
15.1
14.1
13
11.1
10
9.9
9.7
8.7
7.3
5.6
4
3.3
3.2
3
2.3

SECOND TEST.

135
130
126
122
117
112.5
110
107
105
102
98
96
93.5
92
90
88
86
85
83
82.5
Discontinued here.

A. G. SPALDING & CO.

FIRST TEST. BOTTOM READING. SECOND TEST.

167.5
143
124
110
97
90
83
77
72
68
64
60.5
57.5
55
52.5
50.5
48.2
47.5
45
44.7
43
42
41
40
39
38
38
37
36.5
35.5
34.5
34.5
34
33.5
33
32.5
32.5
32.5
31.5
31
31
30.5
30.2
29.8
29.5
29
28.5
27.9

27.3
27
26.5
26.1
25.8
25.6
25.3
25
24.6
24.3
23.9
23.3
23
22.8
22.6
22.4
22.2
22
21.6
21.2
20.6
20.3
19.7
19.2
18.9
18.6
18.4
18.1
18
17.6
17.4
17
16.5
16
15.8
15.5
15.3
15.1
15
14.8
14.7
14.5
14.3
14
13.8
13.3
12.9
12.5

12
11.8
11.5
11.3
11.2
11
10.7
10.5
10.2
9.9
9.6
9.2
8.8
8.5
8.2
8
7.6
7.3
7.2
6.5
6
5.5
5.2
4.7
4.3
3.9
3.6
3.4
3.2
3
2.8
2.5
2
1.5
1.4
1.2
0.9
.3
0.0

9.802 feet head.

162.5
154
146
138
132
126.5
121
116
112
108
104
100.5
96.5
94 8
91.5
88.5
86
84
82
79.5
78
76
74.5
73
71
69.5
68.5
66.5
65.5 23
64
63
62
60.5
60
58.5
58
56.5
56
54.5
54
53
51
50.5
50
49
48.5
47.5
47
46.5

45.5
45
44.5
44
43.5
43
42
41.5
41
40
39.5
39.5
38.5
38
37.5
37.5
37
36.5
35.5
35
35
34.5
34
33.5
33
32.5
32
31.5
30.5
30
29.5
28.5
28
27.5
27.5
27
26.5
26
25.5
25
25
24.5 32
24
23.5
23
22.5
22.5
22
22

21
20.4
19.9
19.5
19.2
18.9
18.5
18
17.3
16.8
16
15.4
14.8
14.5
14.1
13.8
13.3
11.8
11.6
11.2
10.6
9.8
9
8.2
8
7.8
7.5
7.3
7.1
7
6.7
6
5.5
5
4.7
4.5
4.3
4.1
3.9
3.8
3.5
3.2
3
2.9
2.6
2.3
2
2
1.8

1.5
1.3
1
.6
.2
0.0
Blowing.

MORRIS, MANN & REILLY.

BOTTOM READINGS.

FIRST TEST.

120
98
82
72.5
65
58
54
51
47.5
45
42.5
41
39.5
38.5
37.5
37
36
35.5
35
34
3355
33
32.5
32
31.7
31.5
31
30.3
29.7
29
28.3
27.9
27.3
26.9
26.3
26
25.5
25.1
24.8
24.4
24.2
24.1
24
23.9
23.8
23.7
23.5
23.3

23.2
23.1
22.9
22.4
21.7
21.3
20.9
20.4
20.2
19.7
19.3
19
18.6
18.3
18
17.6
17;4
17.3
17.3
17.2
17.2
17.1
17
16.9
16.7
16.3
15.8
15.3
15
14.5
14.2
13.7
13.3
12.9
12.5
12.2
11.5
11.2
11.1
11
11
10.9
10.6
9.9
9.3
8.7
8.1
7.5

6.8
6.4
6
5.6
5.3
4.9
4.9
4.8
4.7
4.7
4.7
4.7
4.6
4.6
4.6
4.5
4.5
4.5
4.4
4.3
4
3.3
2.9
2.4
1.8
1.4
1
.1
0.0

SECOND TEST

121.5
116
112
107.5
103
99
95
92
89
86.5
84.5
82
78.5
77
75
73
71.5
70
68
66.5
65
63.5
62
61.5
60.5
59.5
58.5
57
56.5
56
55.5
54.5
54
52.5
51.5
51
50
49.5
49
48
47.5
46.5
46
45.5
45
44.5
44
43.5
42.5

42
41.5
41
40.5
40.5
40
39.5
39
38.5
38.5
38
37.5
37
36
35.5
35
35
34
33.5
33
32
32
31.5
31
---
---
30.8
30.5
30.2
29.7
29.2
28.7
28
27.5
26.9
26.3
25.6
25.1
24.8
24.5
24.3
24.1
23.9
23.7
23.3
22.8
22.2
21.4
20.7

20.1
19.3
18.8
17.8
17.4
17.3
17.1
16.9
16.7
16.4
15.9
15.2
14.4
13.8
12.7
11.7
10.9
10.4
10.3
10.2
10.1
9.9
9.3
8.4
7.5
6.5
5.3
3.9
2.7
2.5
2.4
2.3
2.2
1.8
1
0.0

THOMPSON & TAYLOR.

EAST RISER. FIRST TEST.

BOTTOM READINGS.

122.5
111
101
92
86
81
76
72
68
65
63
60
57.5
55
52
50.5
47.5
46
43
42
40
38
36.5
35
33
32
30
28.6
27.4
26.1
24.8
23.6
22.5
21.4
20.3
19.3
18.3
17.3
16.3
15.4
14.8
14
13.2
12.4
11.6
10.9
10.3
9.8
9
8.8
8.3
7.7
7
6.4
5.8
5.1
4.3
4
1.9
1
.3
.1
0.0

Water column 2.5 feet.

TOP READINGS.

79
67
57.5
49.5
45
39
35
32
29
26.5
25.5
24
22
19.5
18
16.4
15.2
14
13
12
11.1
10.2
9.4
8.8
8.1
7.4
6.9
6.3
5.9
5.8
5.1
4.9
4.5
4.1
3.9
3.3
3.1
2.8
2.6
2.4
2.1
1.9
1.8
1.6
1.4
1.3
1.2
1.2
1.1
1
.7
.3
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0

THOMPSON & TAYLOR.

EAST RISER. SECOND TEST.

BOTTOM READINGS.	
121	9.1
111	8.5
102	7.9
95	7
88	6
82	5
78	3.5
74	2.3
70	1.9
67.5	1.3
65	0.0
61.5	
58	
55	
53	
50.5	
48.5	
46	
44	
42.5	
40.5	
38	
37	
35	
33	
32	
30	
29	
27.5	
26.5	
25.3	
24	
23.1	
22	
21	
20	
18.9	
18	
17	
16.2	
15.6	
14.9	
14.2	
13.3	
12.7	
12.1	
11.4	
10.7	
10	
9.6	

Water Column
3.25feet.

TOP READINGS.	
82	1.7
71	1.7
61	1.7
52	1.6
49	1.4
43	1.2
39.5	1.1
35	.8
32	.3
29	.1
27	
25	
23.2	
21	
19.8	
18.4	
17.1	
15.9	
14.9	
13.9	
13	
12	
11.2	
10.5	
9.9	
9.1	
8.6	
8	
7.6	
7.1	
6.7	
6.3	
5.8	
5.4	
5.2	
4.9	
4.5	
4.2	
4	
3.7	
3.4	
3.2	
3	
2.9	
2.7	
2.6	

2.3	
2.2	
2.1	
1.9	

A. C. McCLURG & CO. EAST RISER.

FIRST TEST. BOTTOM READINGS.

121
113
105.5
100
94.5
89
83.5
80.5
77
74
70.5
68
65
63
61.5
59.5
57.5
55
54.5
53
51
50
48.5
47.5
46
45
44
43
42.5
41.5
40.5
40
39
38.5
37.5
37
36.5
36
35.5
35
34.5
34
33
32.5
32
29.6
29.2
28.8
28.3
28

27.6
27.2
26.9
26.7
26.1
25.9
25.5
25.2
24.9
24.5
24.3
23.8
23.7
23.5
23.2
23
22.8
22.5
22.2
22
21.8
21.6
21.3
21.1
21
20.8
20.6
20.4
20.2
20.1
20
19.8
19.6
19.4
19.3
19.2
19.1
19
18.8
18.7
18.7
18.5
18.3
18.2
18
18
17.9
17.7
17.6
17.5

17.3
17.2
17
16.7
16.3
16
15.7
15.5
15.1
15
14.8
14.1
13.9
13.5
13.2
13
12.8
12.6
12.7
12.5
12.3
12.3
12.2
12.1
12.1
12
12
11.9
11.9
11.8
11.8
11.6
11.5
11.4
11.2
10.8
10.5
10.2
10
9.8
9.5
9.2
9
8.8
8.5
8
7.9
7.8
7.4
7.2
6.9

6.7
6.5
6.3
6.3
6.3
6.2
6.2
6.1
6.1
6.1
6
6
6
5.9
5.8

TEST NOT COMPLETED.

A. C. McCLURG & CO. WEST RISER.

FIRST TEST. TOP READINGS.

95
90
84
79
74.5
70
66
63
59.5
57
54
51
49
46
45
42
40.5
38.5
37
35
34
32.5
31.5
30
29
28.5
27.5
25.5
25
25
23.5
23
22
21
20
19
18.6
17.4
16.8
16.8
16.2
15.8
15.5
15.2
14.5
13.7
13.3
12.7
12.4
11.8
11.5

11.1
10.8
10.6
9.9
9.6
9.3
8.8
8.5
8.1
7.8
7.5
7.1
6.9
6.6
6.2
6
5.8
5.6
5.2
4.9
4.7
4.5
4.3
4.2
4
3.9
3.8
3.7
3.7
3.6
3.5
3.4
3.3
3.3
3.2
3.1
3.1
3
2.9
2.7
2.6
2.3
2.1
1.9
1.8
1.7
1.4
1.2
1.1
1.0

.9
.7
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.6
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.5
.3
00
00*
.1
.2
.3
.6
.7
.8
.9
1.0
1.0
1.1
1.1
1.1
1.1
1.1
1.1
1.2
1.3
1.4
1.4
1.4
1.5
1.5
1.6
1.6
1.6
1.6
1.6
1.7
1.7
1.9
2.0
2.1
2.2
2.2
2.3
2.4
2.4
2.5
2.6
2.6
2.7
2.8

2.9
3.0
3.1
3.1
3.1
3.2
3.2
3.3
3.3
3.4
3.4
3.4
3.4
3.4
3.5
3.6
3.6
3.6
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3.6
3.6
3.6
3.6
3.6
3.6
3.6
3.8
3.8
3.8
3.8
3.9
3.9
4.0
4.0
4.1
4.1
4.1
4.2
4.2
4.2
4.2
4.3
4.4
4.4
4.5
4.5
4.5
4.5
4.5

4.6
4.6
4.6
4.6

* All readings from star on are vacuum readings in pounds per square inch.

A. C. McCLURG & CO. WEST RISER.

FIRST TEST. BOTTOM READINGS.

120
112
108
101
97
92
88
85
81
78
75
73
70.5
68
66
64.5
62.5
61
59
58
56.5
55
54
53
52.5
50.5
49.5
48
47
46
45
44.5
43.5
42.5
42
41.5
41
40.5
40
39
38.5
38
37.5
37
36
35.5
35
35
35
34.5

34
33.5
33
32.5
32
31.5
31.5
31
30.1
29.9
29.5
29.3
29
28.7
28.5
28.2
27.9
27.5
27.2
27
26.8
26.5
26.3
25.8
25.5
25
24.7
24.2
23.8
23.4
23
22.7
22.2
21.8
21.5
21
20.8
20.3
20
19.8
19.7
19.6
19.5
19.2
19.1
18.9
18.7
18.6
18.4
18.3

18.2
18.1
17.9
17.8
17.7
17.6
17.5
17.3
17.3
17.1
16.9
16.8
16.7
16.6
16.4
16.3
16.2
16
15.7
15.1
14.8
14.5
14.2
13.8
13.4
13.1
12.8
12.5
12.2
12
11.8
11.4
11.1
10.9
10.5
10.3
10.2
10.1
10.1
10
9.9
9.8
977
9.6
9.6
9.5
9.4
9.3
9.2
9.2
9.1

9.1
9
9
9
8.9
8.8
8.8
8.8
8.7
8.5
8.3
8
7.9
7.6
7.2
6.9
6.6
6.3
6
5.7
5.4
5.1
4.9
4.7
4.4
4
3.9
3.6
3.3
3
3
2.9
2.8
2.8
2.5
2.5
2.5
2.4
2.3
2.3
2.2
2.1
2.1
2.1
2.1
2
2
2
1.9
1.7
1.4

1.1
.9
0.0
0.0
0.0
Suction.

Water Column
10.5 feet.

A. C. McCLURG & CO. WEST RISER.

SECOND TEST. BOTTOM READINGS.

121.5
117
113
110
107
103
100
98
95
92.5
90
87.5
85
82.5
80
79
77.5
76
75
72.5
71.5
70
68
67
65.5
65
64
62.5
61.5
80
60
58.5
57.5
56
55
54.5
54
53
53
52
51
50
48
48
47.5
47
45
45
44.5
44
43.5
43
42.5
42
41.5
41
40.5
40
39.5
39.5
38
38
38
38
37
37
36.5
36.5
36
35
35
34.5
34.5
34.5
33.5
33
32.5
32.5
32.5
32
31
30.5
30.1
30
29.8
29.5
29.2
29
28.8
28.5
28
27.8
27.5
27.2
26.9
26.6
26.2
26
25.7
25.3
25
24.8
24.4
24.
23.7
23.4
23.2
23.1
22.9
22.7
22.5
22.4
22.3
22.1
21.9
21.8
21.7
21.5
21.3
21.2
21
20.7
20.5
20.2
19.9
19.7
19.3
19
18.7
18.4
18.1
17.8
17.4
17.1
16.9
16.4
16
15.7
15.3
15.2
15.1
15
14.9
14.7
14.6
14.6
14.5
14.3
14.2
14.1
14
13.9
13.8
13.5
13.3
12.9
12.5
12.1
11.9
11.6
11.2
10.9
10.5
9.9
9.4
9
8.5
8.5
8.4
8.3
8.2
8.1
8
8
7.9
7.7
7.4
7.2
7
6.5
6.2
5.8
5.4
5
4.5
4.3
3.9
3.4
3
2.8
2.3
2
1.7
1.5
1.3
1.2
.1
.9.

A. C. McCLURG & CO. WEST RISER.

SECOND TEST. TOP READING.

99	20.5	6.4	2.3
94.5	19.7	---	2.2
91	19.3	6.4	2.1
87	18.8	---	2
84	18.3	6.5	1.9
80.5	17.7	6.4	1.9
78	17.4	6.2	1.9
74.5	17	6.1	1.8
71.5	16.5	5.9	1.8
69	16.2	5.7	1.8
66.5	15.5	5.4	1.8
64.5	15	5.2	1.7
62	14.7	---	1.7
60	14.4	---	1.7
58	14	4.9	1.8
56	13.6	4.8	1.9
54.5	13.3	4.7	---
52.5	12.9	4.5	1.7
51	12.6	---	1.6
49.5	12.3	4.3	1.5
48.5	11.9	4.1	1.4
46.5	11.6	4	1.3
45	11.3	3.9	1.3
44	11	3.9	1.2
42.5	10.9	---	1.1
41	10.6	3.8	1
40.5	10.3	3.7	1
39	10	3.6	1
38	9.8	3.6	.9
37	9.5	---	.9
36	9.2	3.5	.8
35	8.9	3.5	.7
34.5	8.7	3.4	.7
33.5	8.4	3.4	.6
32.5	8.2	3.3	.6
32	7.9	3.5	.6
31	7.8	3.5	.5
30	.75	3.5	.5
29	7.3	---	.5
28.5	7.2	3.4	.5
28	7	---	.4
27	6.9	3.4	.4
26	6.8	3.3	.4
25	6.8	3.1	.4
24.5	6.7	2.9	.3
24	6.6	2.9	.2
23	6.6	2.7	.2
22.5	6.5	2.6	.1
22	6.4	2.5	
21.5	6.3	2.4	

TRUAX, GREEN & CO.

FIRST TEST.

BOTTOM READINGS.				TOP READINGS.			
127.5	32	18.8	5.1	91	--	--	--
114.5	31.5	18.5	4.8	79.5	--	--	--
104.5	31.5	18.2	4.3	68.5	3.67	--	--
97	31	18	4	61	--	--	--
90	31	17.8	3.6	54.5	--	--	--
85	31	17.4	3.2	48	--	--	--
79	30.8	17.2	2.8	43	--	--	--
75	30.5	17	2.4	38.5	--	--	6.18
72	30	16.8	2	35	--	--	--
68	29.7	16.5	2	31.5	--	5.3	--
65	29.1	16.4	2	28.5	--	--	--
63	28.8	16.3	2	25.5	--	--	--
60	28.2	16.3	1.9	23	--	--	--
57	27.9	16.1	1.8	21	4.5	--	--
55	27.4	16.1	1.7	19	--	--	6.22
53.5	27	16	1.6	17	--	--	
52	26.7	15.7	1.4	--	--	--	
51	26.2	15.2	1.2	--	--	--	
49	26	14.8		12	--	--	
48	25.7	14.2	WATER COLUMN	--	--	--	
46.5	25.3	13.8	15 FEET.	--	--	--	
45	25	13.5		8.5	--	5.45	
44.5	24.8	13.5		--	4.46	--	
43	24.4	13.1		--	--	--	
42.5	24.1	13		5	--	--	
41.5	23.9	12.9		--	--	--	
41	23.7	12.5		--	--	--	
40.5	23.5	12.1		--	--	--	
40	23.3	11.9		--	--	--	
39	23.2	11.5		--	--	--	
38.5	23.1	11		--	--	--	
38	23	10.7		00	--	-6.53	
37.5	22.8	10.2		--	--	--	
37	22.8	9.9		--	--	--	
36	22.7	9.8		--	--	--	
36	22.7	9.7		--	5.2	--	
35	22.4	9.6		--	--	--	
35	22.2	9.6		--	--	--	
35	21.9	9.6		--	--	--	
34.5	21.5	9.5		--	--	--	
34	21.1	9.3		--	--	--	
33.5	20.8	8.9		.637*	--	--	
33.5	20.4	8.3		--	--	--	
33	20.1	7.9		--	--	--	
33	19.8	7.4		--	--	--	
32.5	19.3	7		--	--	--	
32	19	6.5		--	5.3	6.03	
32		6		--	--	--	
		5.5		--	--	--	

*All readings from star on are vacuum readings in inches of mercury.

TRUAX, GREEN & CO.

SECOND TEST.

BOTTOM READINGS.

125.5
120.5
117
113
109
106
103
100
98
95
92
90
87
85
83
81.5
80
78
77
75
73.5
72.5
71
70
69.5
68
67
66
65
63.5
62.5
61
60.5
60
59
58
57
57
56
55
55
54
53
52
52
51.5
52
51
50
50
50

48.5
48
48
47.5
47
46.5
46
45
45
44.5
44.5
43
42.5
42
42
41.7
41.5
40.8
40
40
39.8
39.5
39
38
38
37.5
37
37
36.5
36
36
35.5
35
35
34
34
33.5
32
32
32
32
31.5
30.5
30.5
29
29
29
28.7
28.5
28.2
27.8

27.3
26.7
26
25.4
25.3
25
24.7
24.3
24
23.5
23
22.5
22
21.4
21
20.8
20.7
20.5
20.3
20.2
20
19.7
19.0
18.5
18
17.3
16.8
16.2
15.8
15.3
14.8
14.2
13.5
13
12.5
12.2
12
12
11.8
11.7
11.5
11.2
10.5
10
9.3
8.8
8.1
7.7
7.5
7
6.5

6
5.5
5.1
4.7
4
3.7
3.2
2.6
2.4
2.3
2.2
2.1
2
1.9
1.5

TOP READINGS.

88.5	--	--	--
84.5	--	--	--
80.5	8	--	--
76	--	--	--
72	--	--	--
69.5	--	--	0
66	--	--	---
63	--	--	--
60.5	--	--	--
58	7.5	--	--
55.5	--	2	--
53	--	--	0
51	--	--	
49	--	--	
46.5	--	--	
45	--	--	
43	--	--	
41	--	--	
39.5	--	--	
38	7	1	
--	--	--	
--	--	--	
34.5	--	--	
--	--	--	
--	--	--	
31	--	--	
--	--	--	
--	--	--	
28	5.5	--	
--	--	--	
--	--	--	
24.5	--	--	
--	--	--	
--	--	0	
22	--	---	
--	--	--	
--	--	--	
19.5	--	--	
--	--	--	
--	5	--	
17	--	--	
--	--	0	
--	--	--	
15	--	--	
--	--	--	
--	--	--	
13	--	--	
--	--	--	
12	--	--	
--	--	--	
--	3	0	
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ALBERT PICK & CO.

NORTH RISER. EAST SECTION. FIRST TEST.

BOTTOM READINGS.

121	18.3
108	17.6
97	16.7
87.5	16
80.5	15.2
74	14.3
69	14.2
65	14
61	13.9
57	13.7
54	13
52	12.3
49	11.5
47	10.8
45	10
43	9.4
41.5	8.8
40	8
38	7.8
37.5	7.8
35.5	7.5
35	7.3
33.5	7.2
32.5	7.1
32	7
31.7	6.8
30.5	6
30	5.2
29.3	4.3
28.7	4
28	3.8
27.3	3.8
26.9	3.5
2622	3.3
25.7	3.2
25.1	3.1
24.5	3
24	2.5
23.3	1.7
22.8	Water column
21.9	8 feet.
21.2	
20.9	
20.4	
20.1	
20	
19.6	
19.1	

TOP READINGS.

93	0.0
81	0.0
70	0.0
62	0.0
55	0.0
49	0.0
44	0.0
39.5	0.0
35.5	0.0
32	0.0
29.5	0.0
27.2	0.0
24.5	0.0
23.5	0.0
20.6	0.0
18.7	0.0
17	0.0
15.5	0.0
14.1	0.0
12.8	0.0 *
11.6	.8
10.5	1.2
9.5	1.6
8.4	1.8
7.4	2
6.5	2.1
5.7	2
4.9	1.8
4.2	1.9
3.4	2.2
2.8	2.4
2.4	2.6
2	2.8
1.8	3
1.7	3.3
1.6	3.5
1.5	3.7
1.4	3.7
1.4	
1.3	
1.6	
1.7	
1.4	
1.2	
.8	
0.0	
0.0	
0.0	
0.0	

* All readings from star on are vacuum readings in inches of mercury.

ALBERT PICK & CO.

NORTH RISER. EAST SECTION. SECOND TEST.

BOTTOM READINGS.

121
112
105
98.5
93
87.5
82
78.5
74.5
71
68
65.5
63.5
61
58.5
57
55
53
51
50
48.5
47
45.5
44
43
42
40.5
39
38.5
37
36
35.5
35
34
33
32
32
31
29.8
28.8
27.9
26,8
25.8
25.2
24.7
24.1
23.8
23.4
22.8
22
21.3
20.5
19.8
19
18
17.3
16.4
16
15.1
14.8
14.6
14.2
13.9
13.6
12.9
11.8
11.1
10.2
10
9.8
9.5
9.3
9.2
9
8.6
8.2
7.6
6.7
5.7
4.8
4.2
4
3.9
3.7
3.5
3.3
3.1
2.8
2

TOP READINGS.

94
85
78
72
67
62
57
53
49
46
43
40
37
35
33
31.5
30.1
28.5
26.9
25.3
24
23
22.1
21.2
20.5
19.8
19.1
18.7
18.1
17.8
17.4
16.8
16
15.3
14.7
14.1
13.7
13.3
13
12.7
12.5
12.4
12.3
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11,5
11
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10.3
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4.3
4.1
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3.8
3.8
3.4
3.1
3
2.9
2.7
2.5
2.2

MARSHALL FIELD & CO.

SECOND TEST. BOTTOM READINGS.

175
172
170
168
167
166
164
163
162
160
159
158
157
156
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144.5
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63
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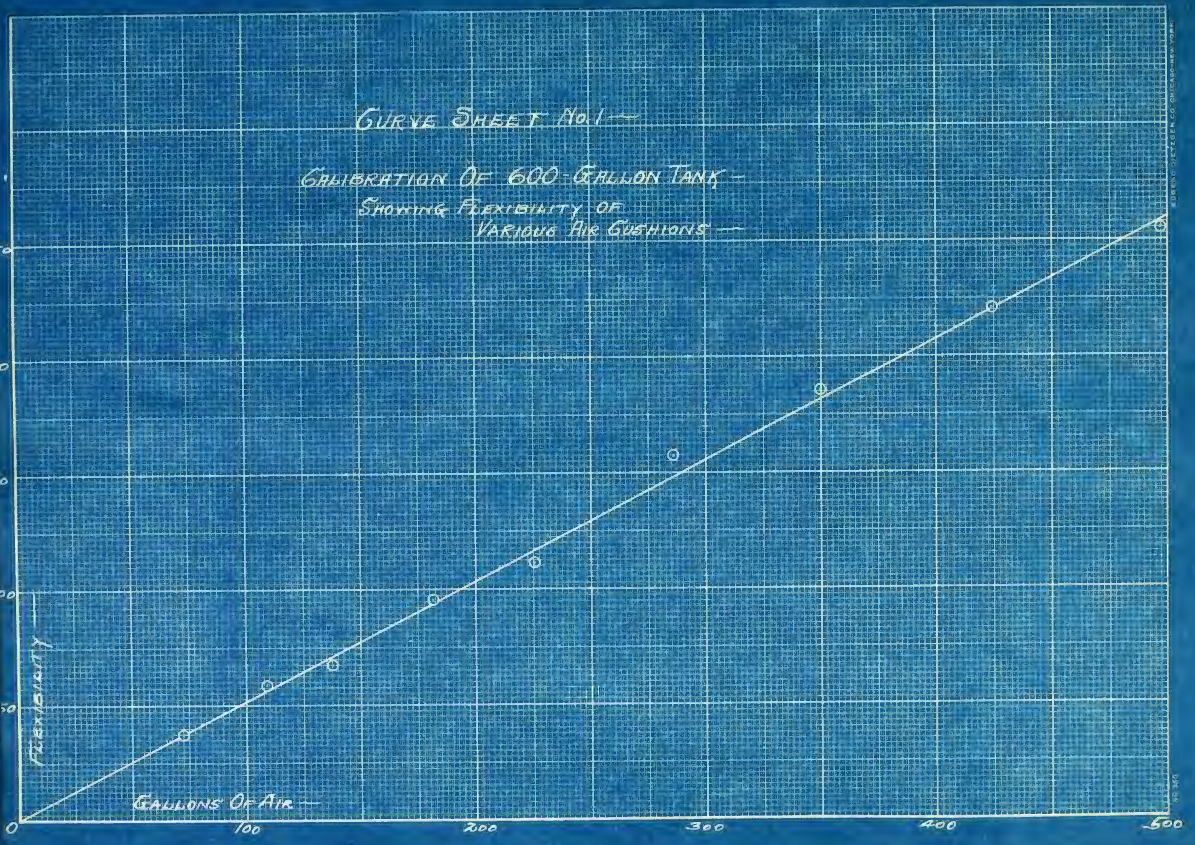
62.5
62.5
62.5
62
61.5
61
60.5
60.5
60
59.5
59

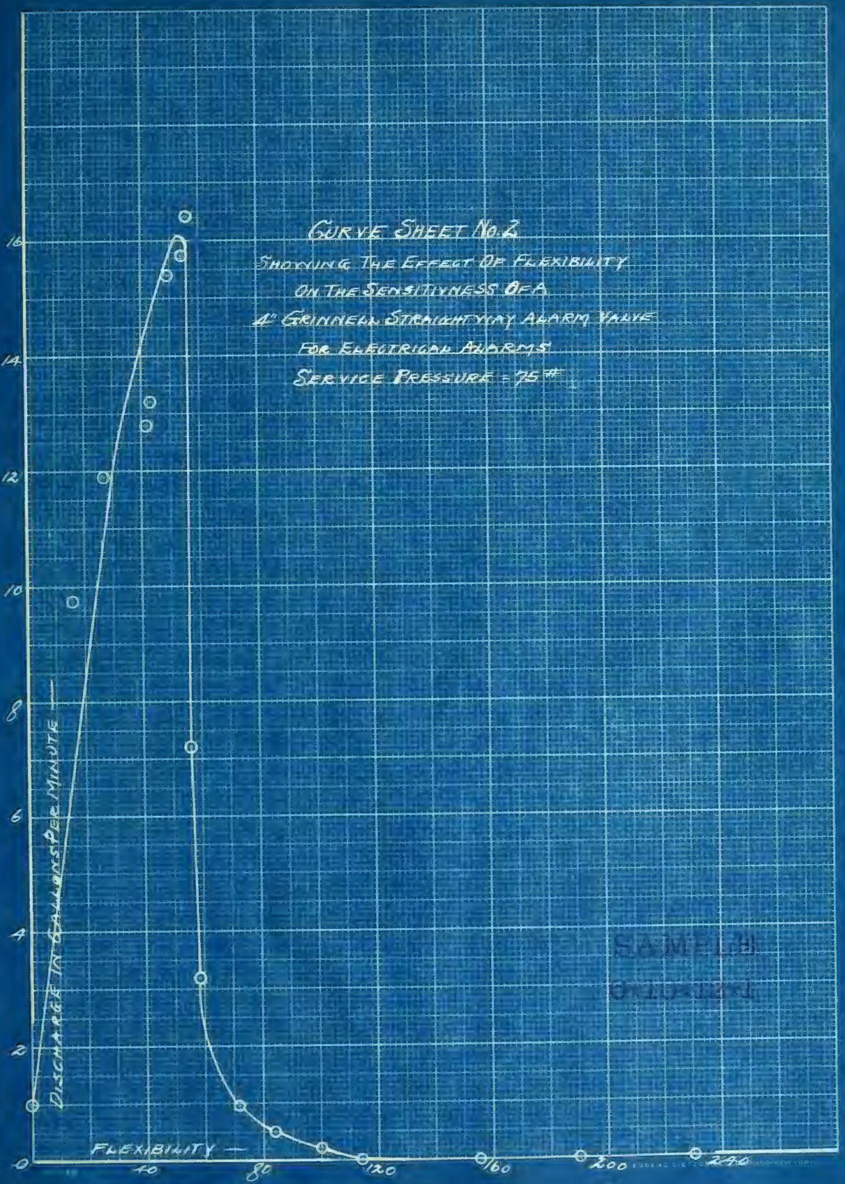
INSTALLATIONS.	FLEXIBILITY.				
	Between 60.# and 120.#	At 175.#	At 120.#	At 85.#	At 60.#
Chicago Mercantile Co.	1. 104		8	20	48
	2.				
Wilson Bros.	S.W. 142		12	32	52
	N.W. 184		18	40	64
A. G. Spalding.	1. 36	2	4	8	16
	2. 108	3	10	20	40
Morris, Mann & Reilly.	1. 22	2	4	4	12
	2. 98		10	17	48
Thomson & Taylor.	44		4	8	20
A. C. McClurg & Co.	W.1 68		4	16	36
	W.2 120		12	20	40
	E.1 64		8	16	24
Truax, Green & Co.	1. 48		5	8	22
	2. 122		10	24	68
Albert Pick & Co.	1. 32		4	6	16
	2. 52		6	10	24
Underwriters' Laboratories	44		4	8	20
Marshall Field & Co.	2. 808	23	108	128	125
40 gal. air cushion,	40		4	7.5	16
Max. and Min.	32-800	2-23	4-108	4-128	12-125
Same, barring M. F. & Co.	32-184	2-3	4-18	4-40	12-68
Conditions to be met.		5	25	50	75



CURVE SHEET No. 1 —

CALIBRATION OF 600-GALLON TANK —

SHOWING FLEXIBILITY OF VARIOUS AIR CUSHIONS —

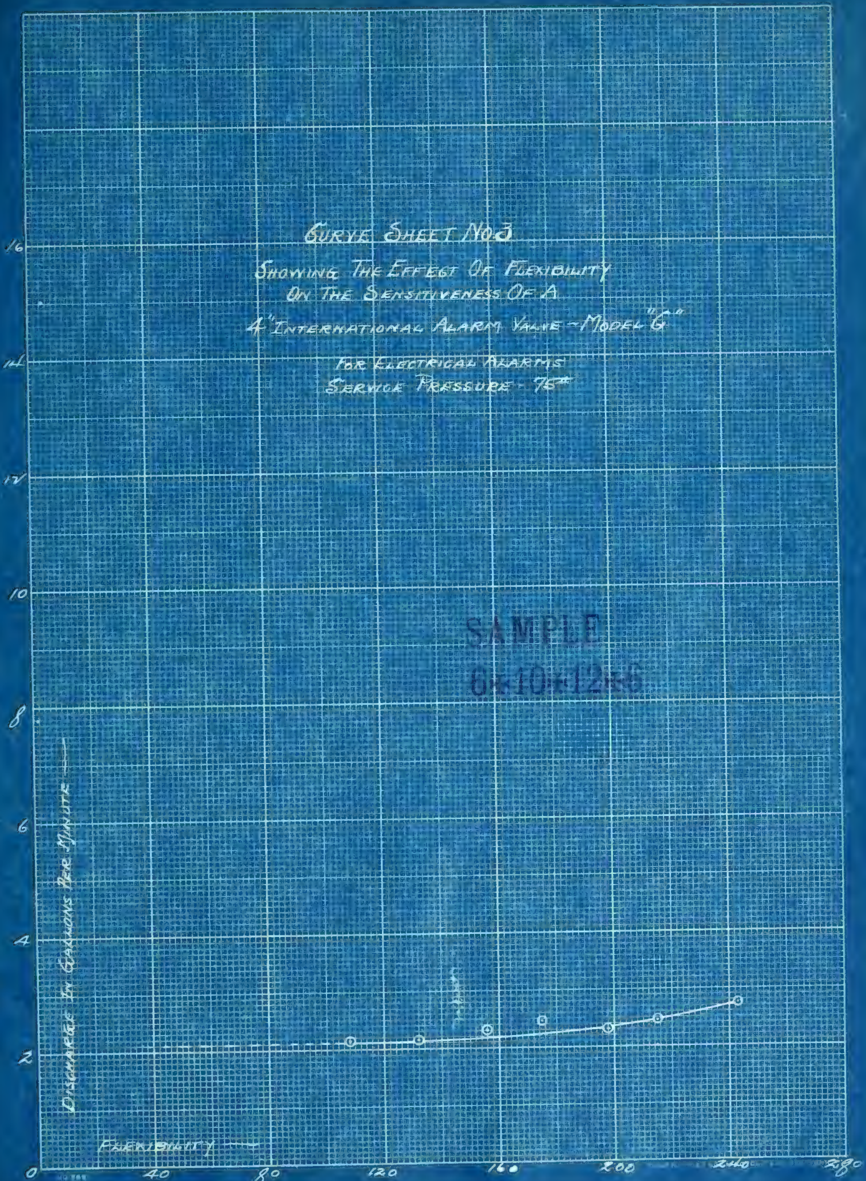


CURVE SHEET No. 2

SHOWING THE EFFECT OF FLEXIBILITY ON THE SENSITIVNESS OF A 4" GRINNELL STRAIGHTWAY ALARM VALVE FOR ELECTRICAL ALARMS

SERVICE PRESSURE = 75#

SAMPLE

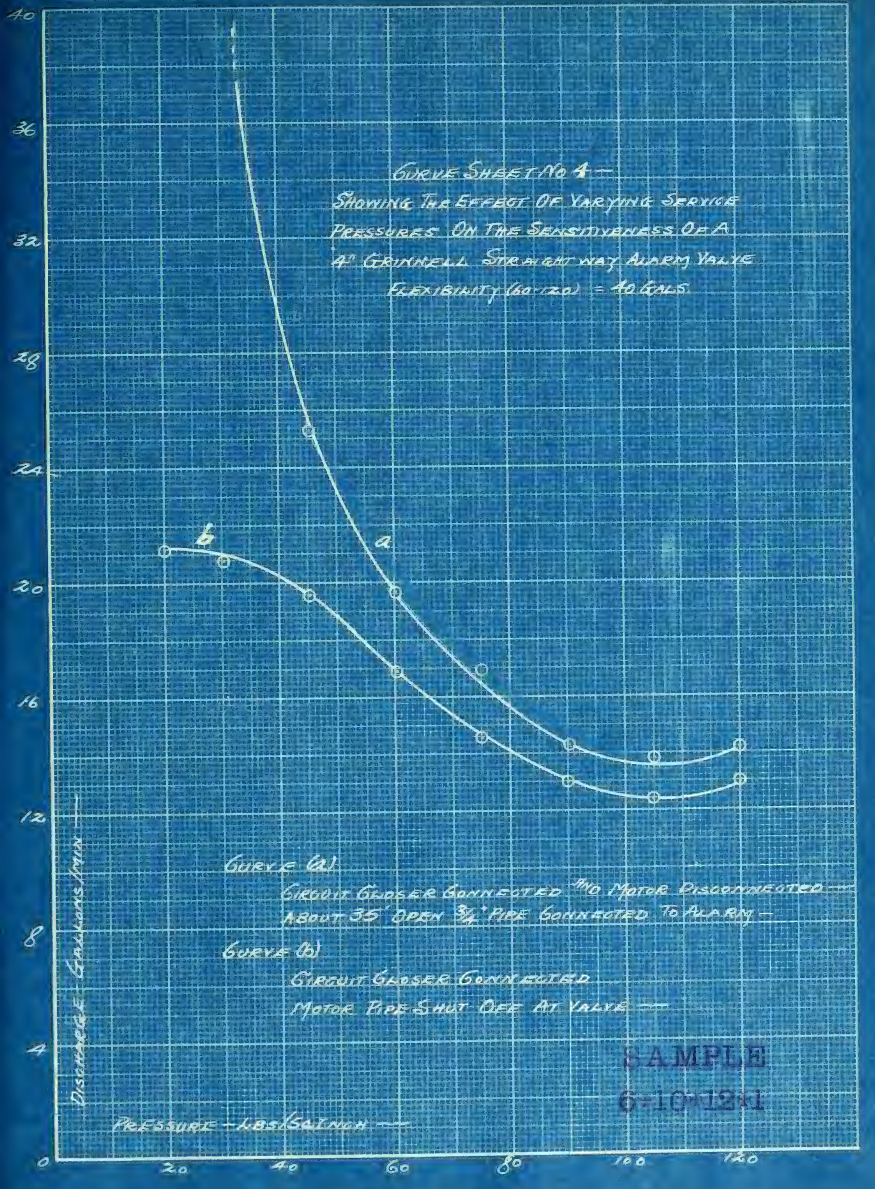


Curve Sheet No 3

Showing The Effect Of Flexibility
On The Sensitiveness Of A
4" International Alarm Valve – Model "G"

For Electrical Alarms
Service Pressure - 75#

SAMPLE
6x10x12x6



CURVE SHEET NO 4 —

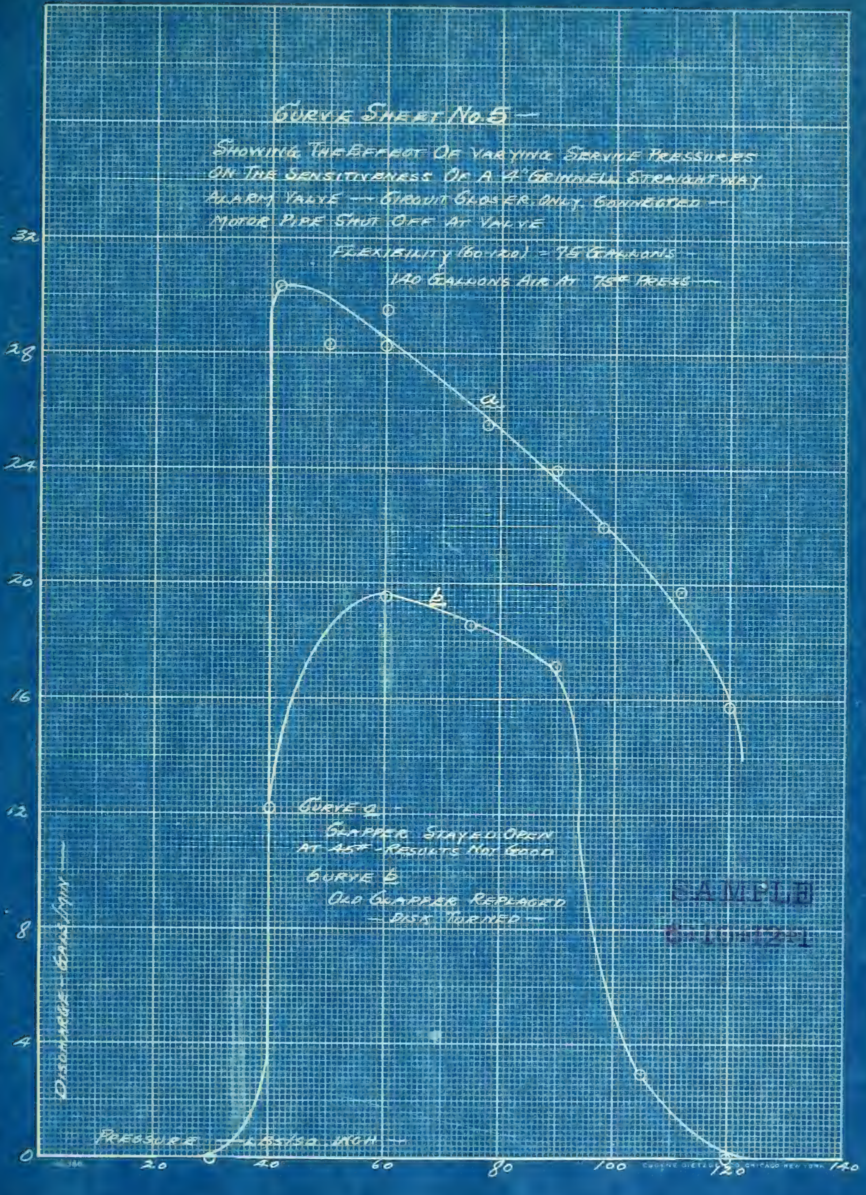
SHOWING THE EFFECT OF VARYING SERVICE PRESSURES ON THE SENSITIVENESS OF A 4" GRINNELL STRAIGHTWAY ALARM VALVE

FLEXIBILITY (60-120) = 40 GALS

CURVE (a)
CIRCUIT CLOSER CONNECTED AND MOTOR DISCONNECTED —
ABOUT 35' OPEN 3/4" PIPE CONNECTED TO ALARM —

CURVE (b)
CIRCUIT CLOSER CONNECTED
MOTOR PIPE SHUT OFF AT VALVE —

SAMPLE
6-10-1211



CURVE SHEET NO. 5 —

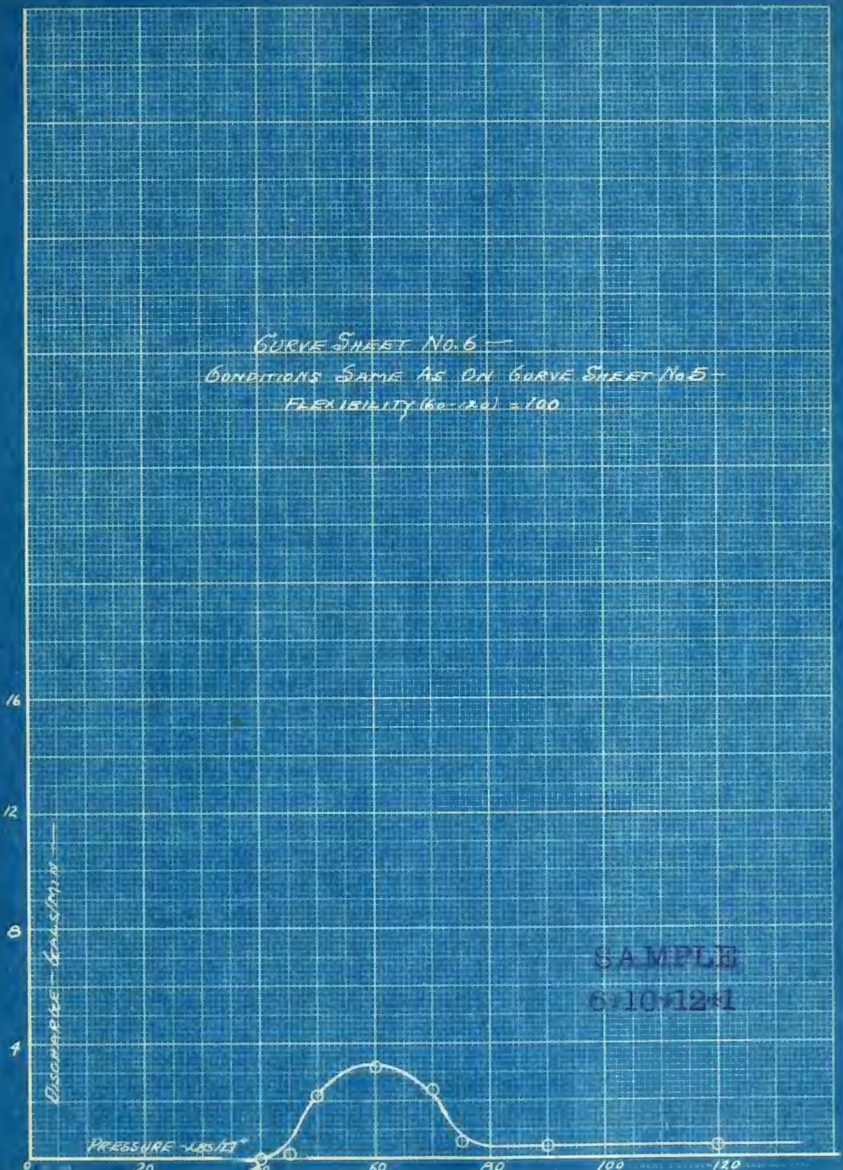
SHOWING THE EFFECT OF VARYING SERVICE PRESSURES
ON THE SENSITIVENESS OF A 4" GRINNELL STRAIGHTWAY
ALARM VALVE — CIRCUIT CLOSER ONLY CONNECTED —
MOTOR PIPE SHUT OFF AT VALVE

FLEXIBILITY (60-120) = 75 GALLONS
140 GALLONS AIR AT 75# PRESS —

CURVE a —
CLAPPER STAYED OPEN
AT 45# — RESULTS NOT GOOD

CURVE b
OLD CLAPPER REPLACED
— DISK TURNED —

SAMPLE

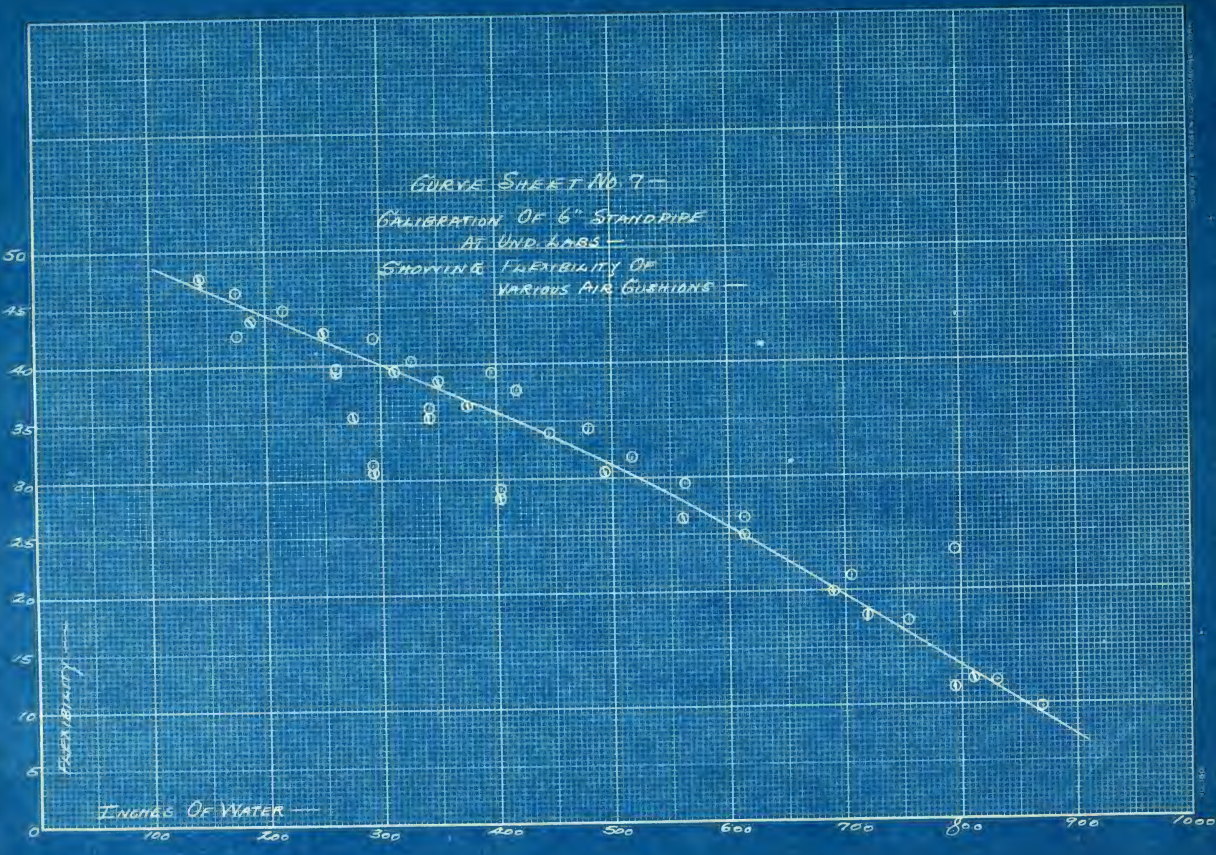


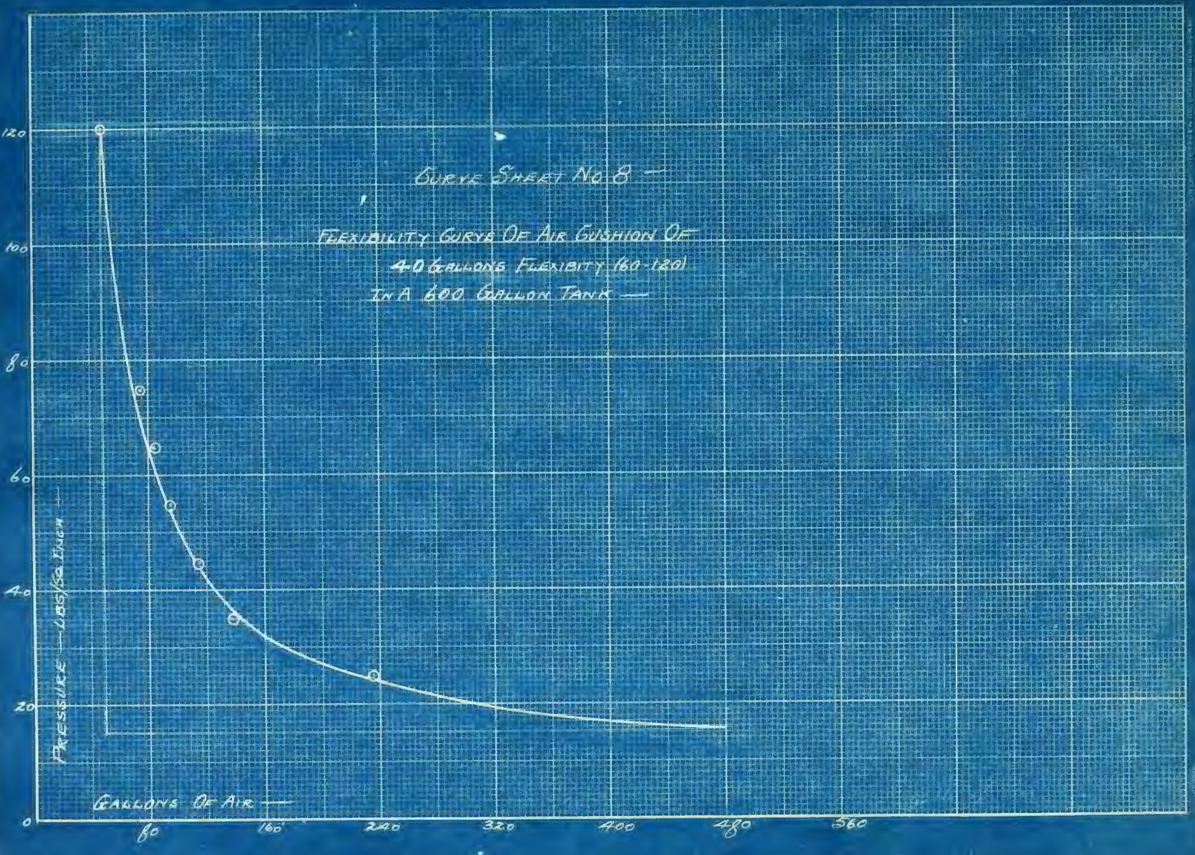
CURVE SHEET NO. 6 —

CONDITIONS SAME AS ON CURVE SHEET NO. 5 —

FLEXIBILITY (60-120) = 100

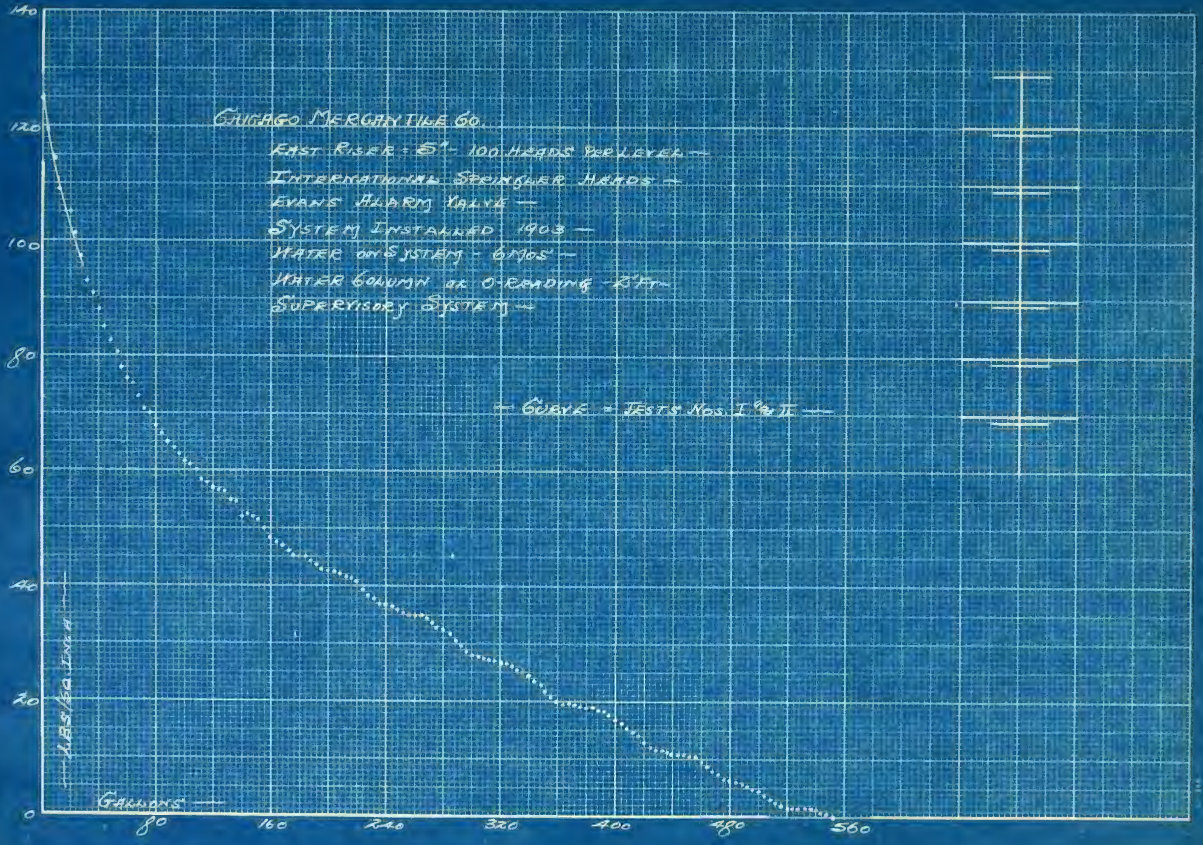
SAMPLE
6-10-1241


Curve Sheet No 7 —
Calibration Of 6" Standpipe
At Und. Labs —
Showing Flexibility Of
Various Air Cushions —
Flexibility —
Inches Of Water —
0
5
10
15
20
25
30
35
40
45
50
100
200
300
400
500
600
700
800
900
1000



CURVE SHEET No 8 —

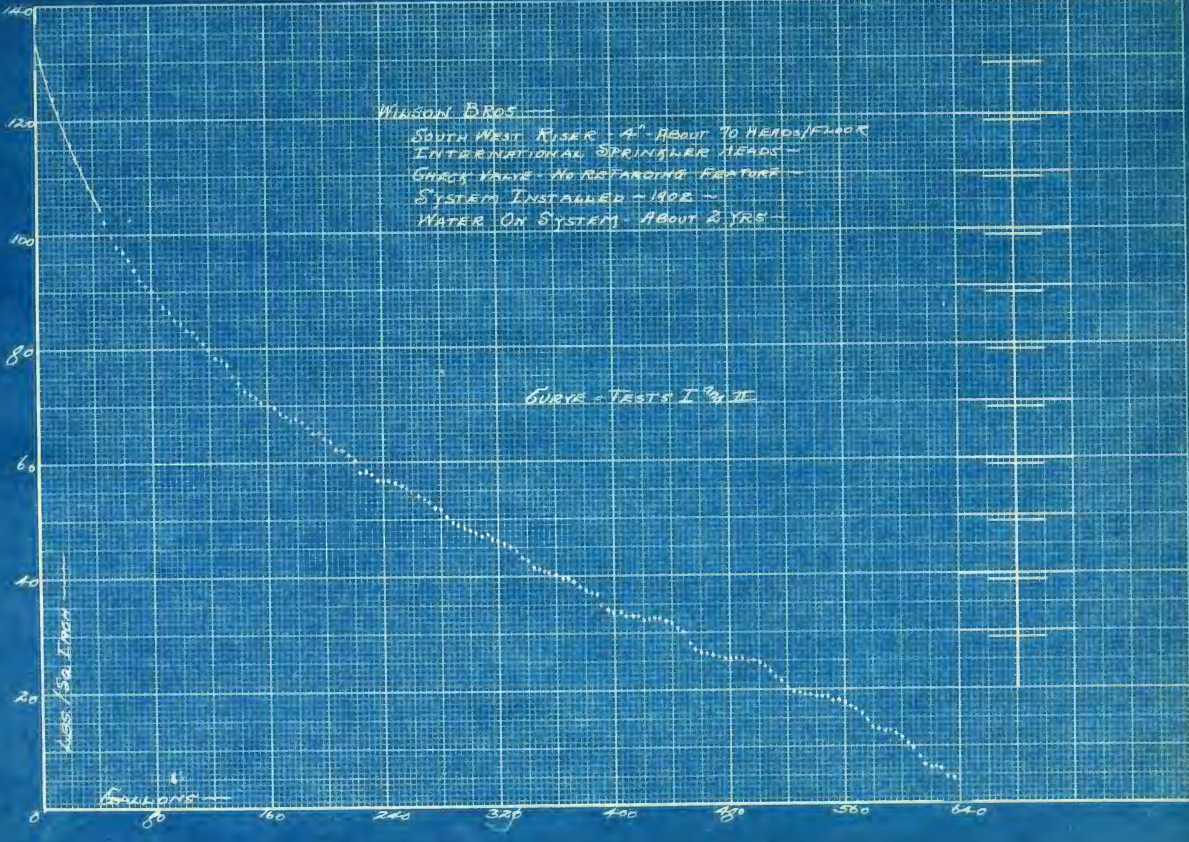
FLEXIBILITY CURVE OF AIR CUSHION OF
40 GALLONS FLEXIBITY (60-120)
IN A 600 GALLON TANK —

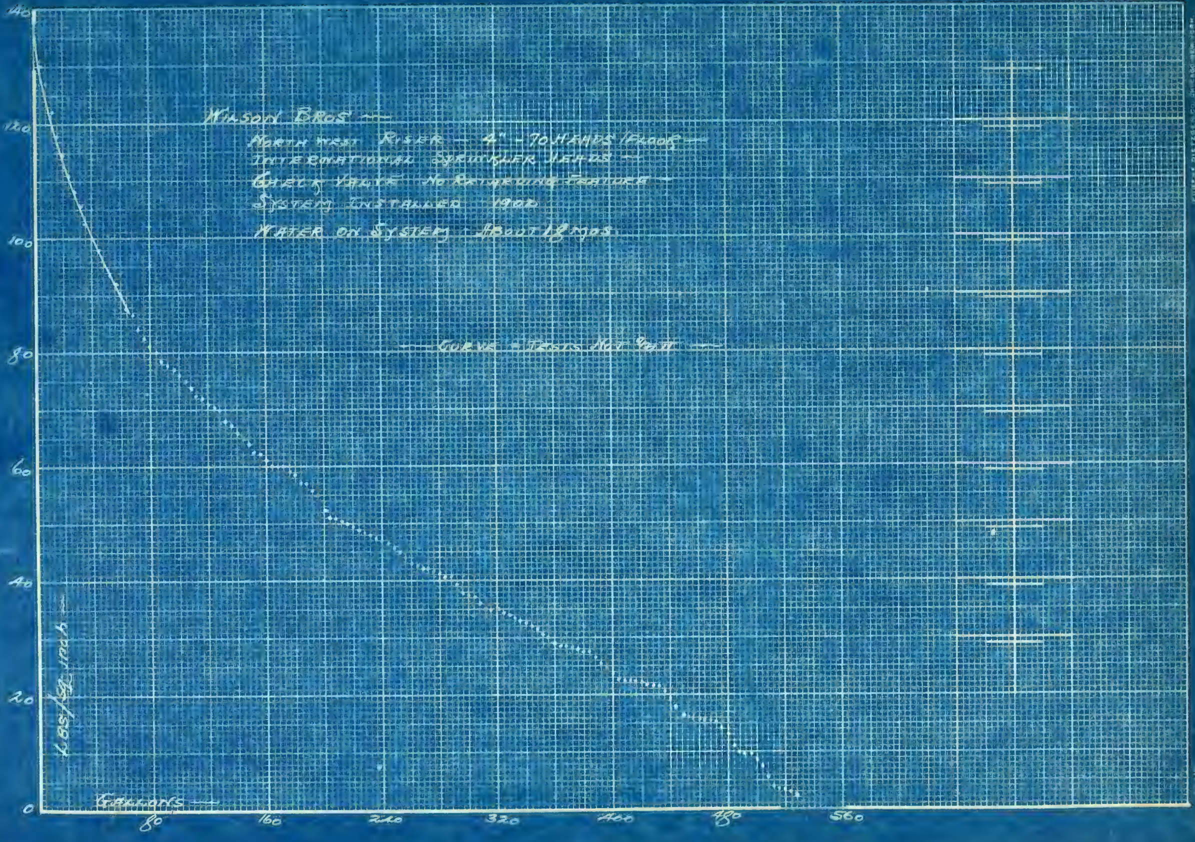


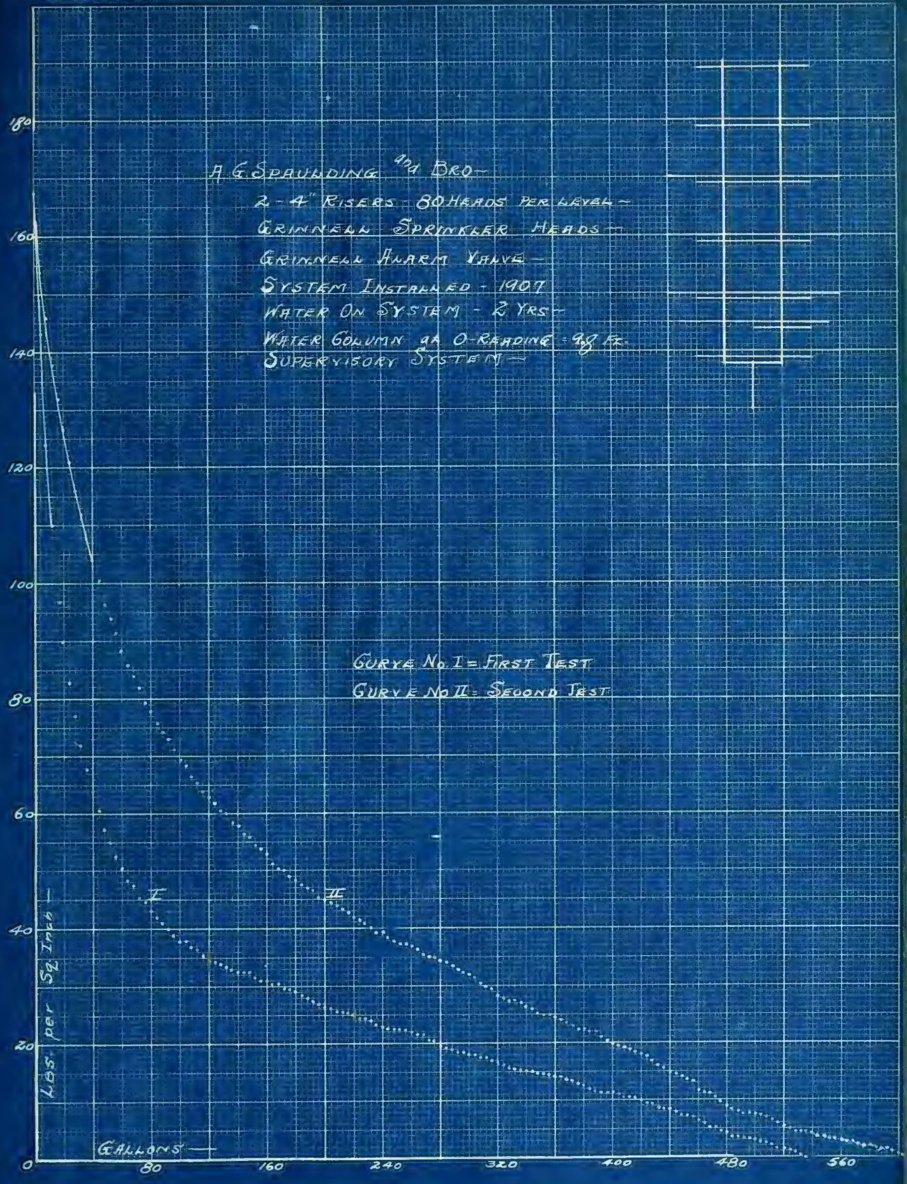
CHICAGO MERCANTILE CO.

EAST RISER - 5" - 100 HEADS PER LEVEL —
INTERNATIONAL SPRINKLER HEADS —
EVANS ALARM VALVE —
SYSTEM INSTALLED 1903 —
WATER ON SYSTEM - 6 MOS —
WATER COLUMN AT 0-READING - 2 FT —
SUPERVISORY SYSTEM —

— CURVE - TESTS NOS. I & II —


WILSON BROS —
SOUTH WEST RISER - 4" - ABOUT 70 HEADS/FLOOR
INTERNATIONAL SPRINKLER HEADS —
CHECK VALVE - NO RETARDING FEATURE —
SYSTEM INSTALLED - 1902 —
WATER ON SYSTEM - ABOUT 2 YRS —
CURVE - TESTS I and II
LBS./SQ. INCH
GALLONS
140
120
100
80
60
40
20
0
80
160
240
320
400
480
560
640


WILSON BROS —
NORTH WEST RISER — 4" – 70 HEADS / FLOOR —
INTERNATIONAL SPRINKLER HEADS —
CHECK VALVE NO RETARDING FEATURES —
SYSTEM INSTALLED 1900
WATER ON SYSTEM ABOUT 18 MOS.
— CURVE — TESTS NOT [illegible] —
LBS/SQ INCH
GALLONS —
0
20
40
60
80
100
120
140
80
160
240
320
400
480
560



A. G. Spaulding and Bro.

2 - 4" Risers 80 Heads per level

Grinnell Sprinkler Heads

Grinnell Alarm Valve

System Installed - 1907

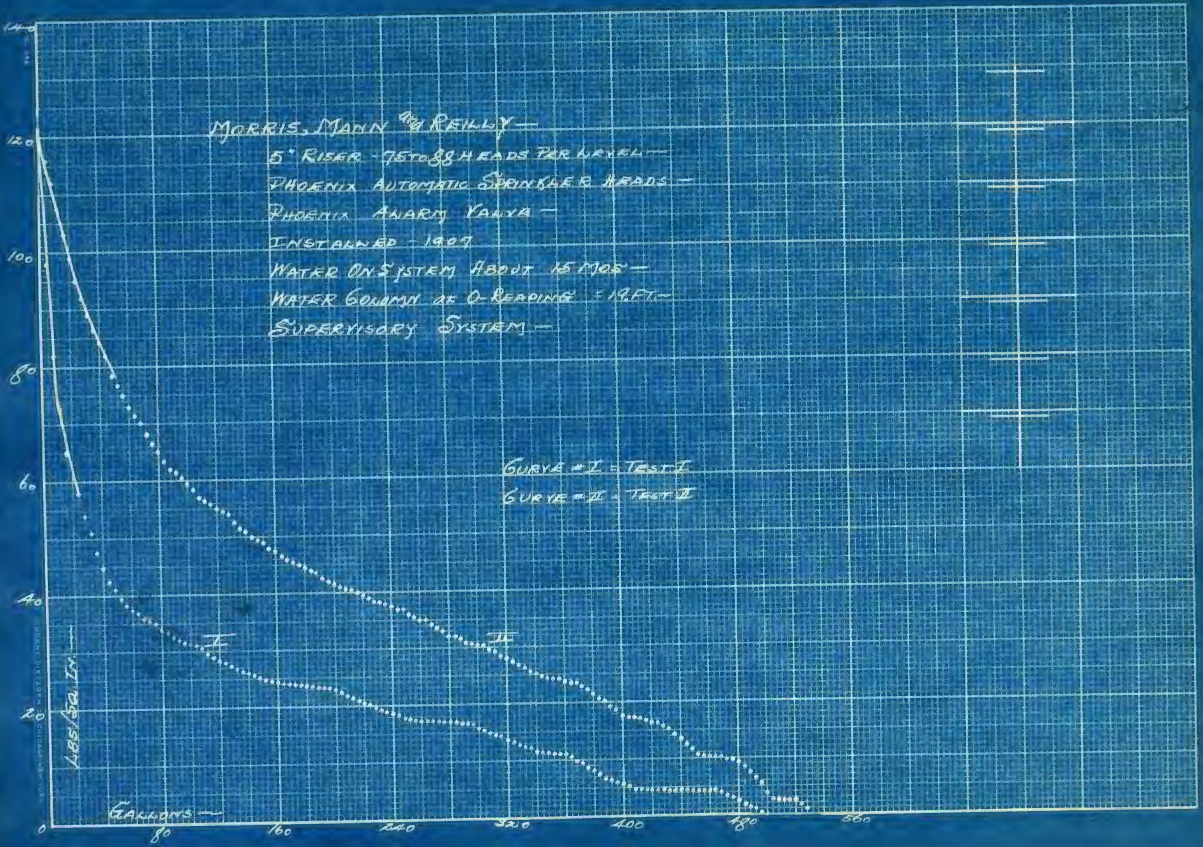
Water on System - 2 Yrs.

Water Column at 0-Reading = 9.8 Ft.

Supervisory System

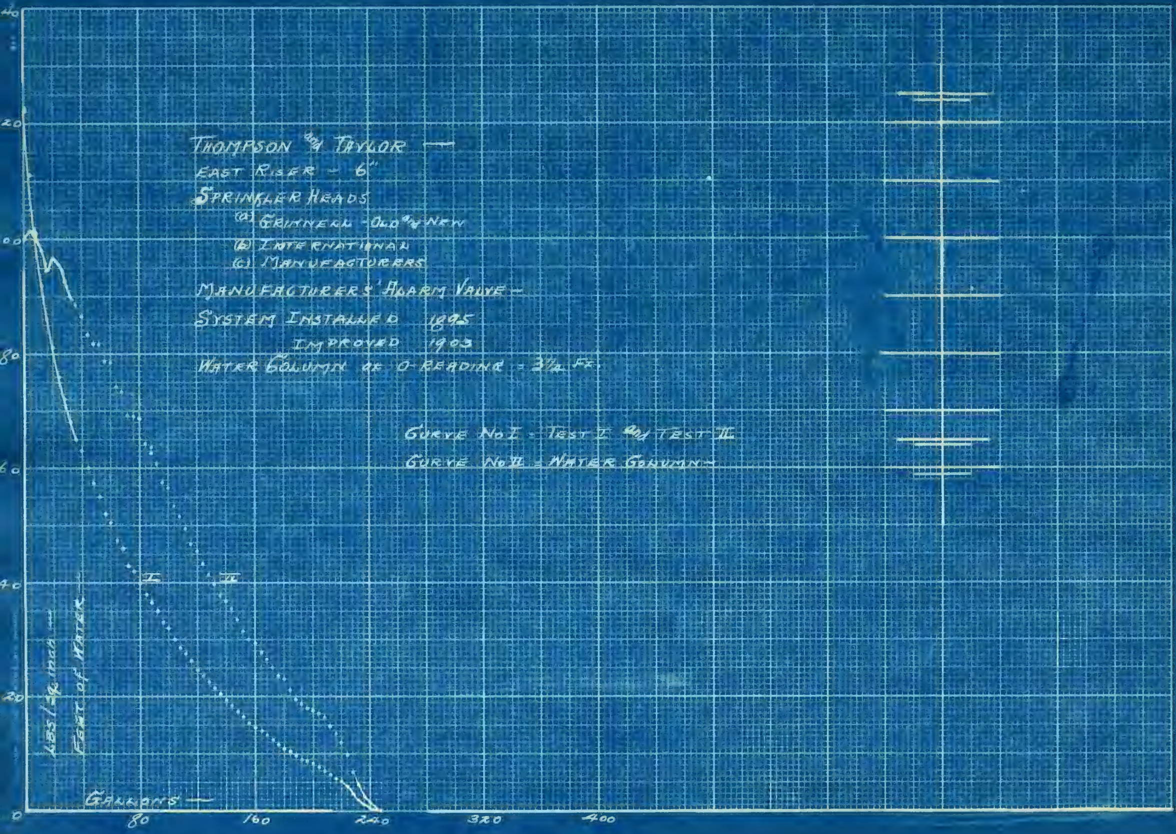
Curve No. I = First Test

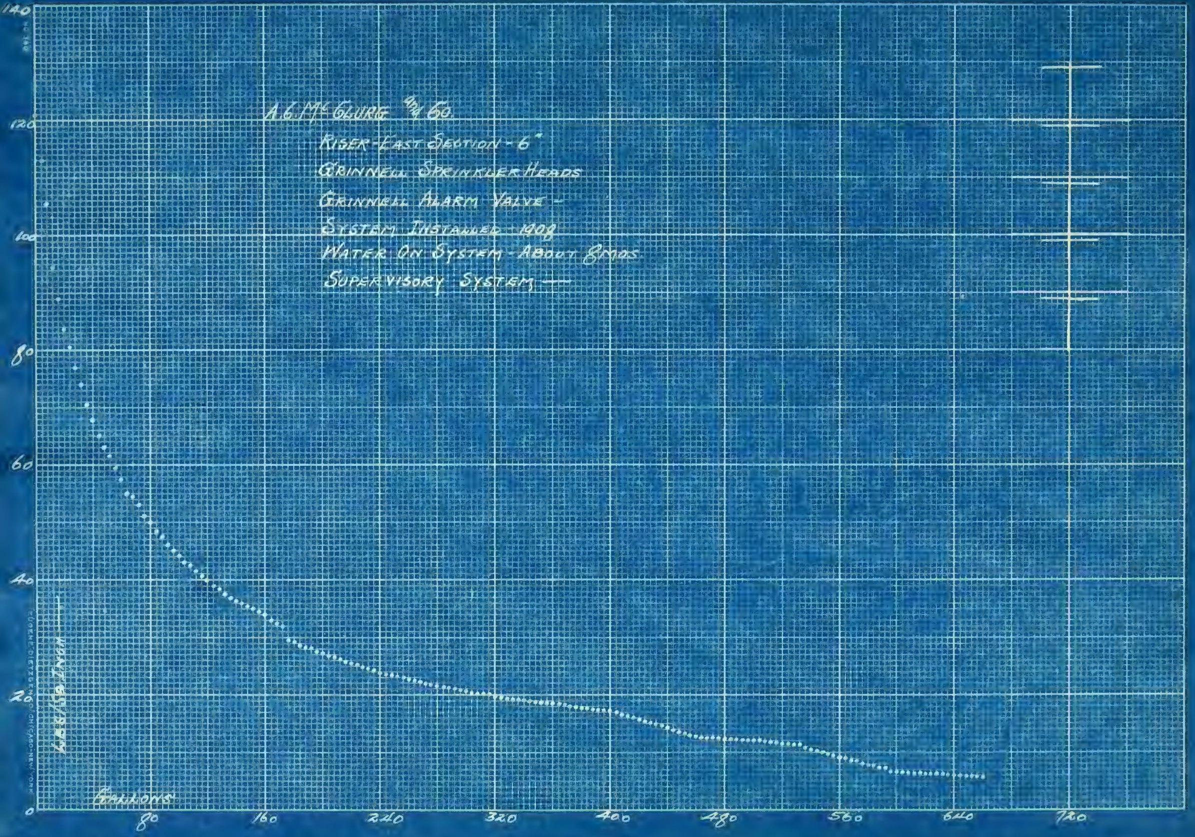
Curve No II = Second Test



MORRIS, MANN & REILLY—
5" RISER - 75 TO 88 HEADS PER LEVEL—
PHOENIX AUTOMATIC SPRINKLER HEADS—
PHOENIX ALARM VALVE—
INSTALLED - 1907
WATER ON SYSTEM ABOUT 15 MOS—
WATER COLUMN AT 0-READING = 19 FT—
SUPERVISORY SYSTEM—

CURVE #I = TEST I
CURVE #II = TEST II


THOMPSON and TAYLOR —
EAST RISER – 6"
SPRINKLER HEADS
(a) GRINNELL – OLD and NEW
(b) INTERNATIONAL
(c) MANUFACTURERS
MANUFACTURERS' ALARM VALVE —
SYSTEM INSTALLED 1895
IMPROVED 1903
WATER COLUMN AT 0-READING = 3½ FT.
CURVE No I – TEST I and TEST II
CURVE No II – WATER COLUMN —
LBS / sq. inch —
FEET of WATER —
GALLONS —
I
II
40
20
00
80
60
40
20
0
80
160
240
320
400


A.G. McClure & Co.

Riser-East Section-6"

Grinnell Sprinkler Heads

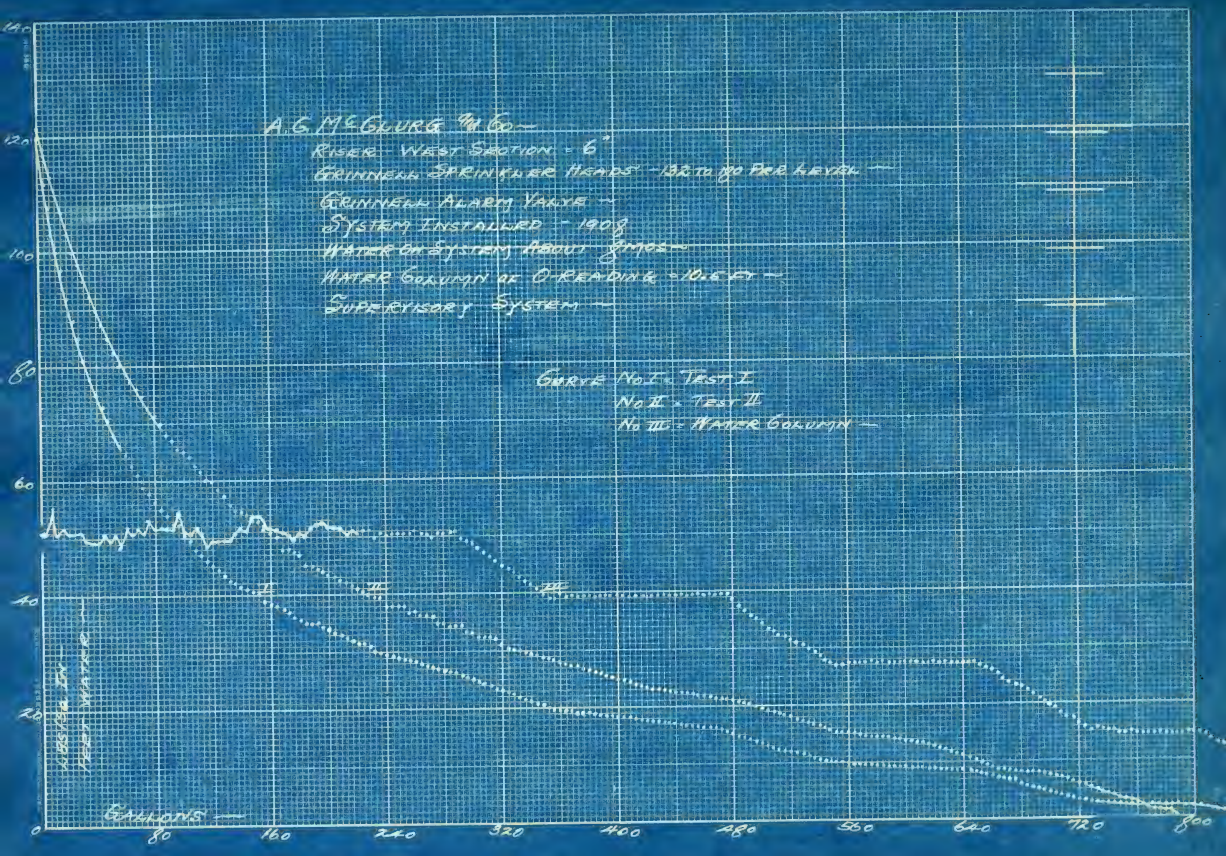
Grinnell Alarm Valve-

System Installed-1909

Water On System-About 8 mos

Supervisory System—

EUGENE DIETZGEN CO. CHICAGO-NEW YORK



A. G. McClurg & Co. —

Riser West Section = 6"

Grinnell Sprinkler Heads — 132 to 180 Per Level —

Grinnell Alarm Valve —

System Installed — 1908

Water on System About 3 mos. —

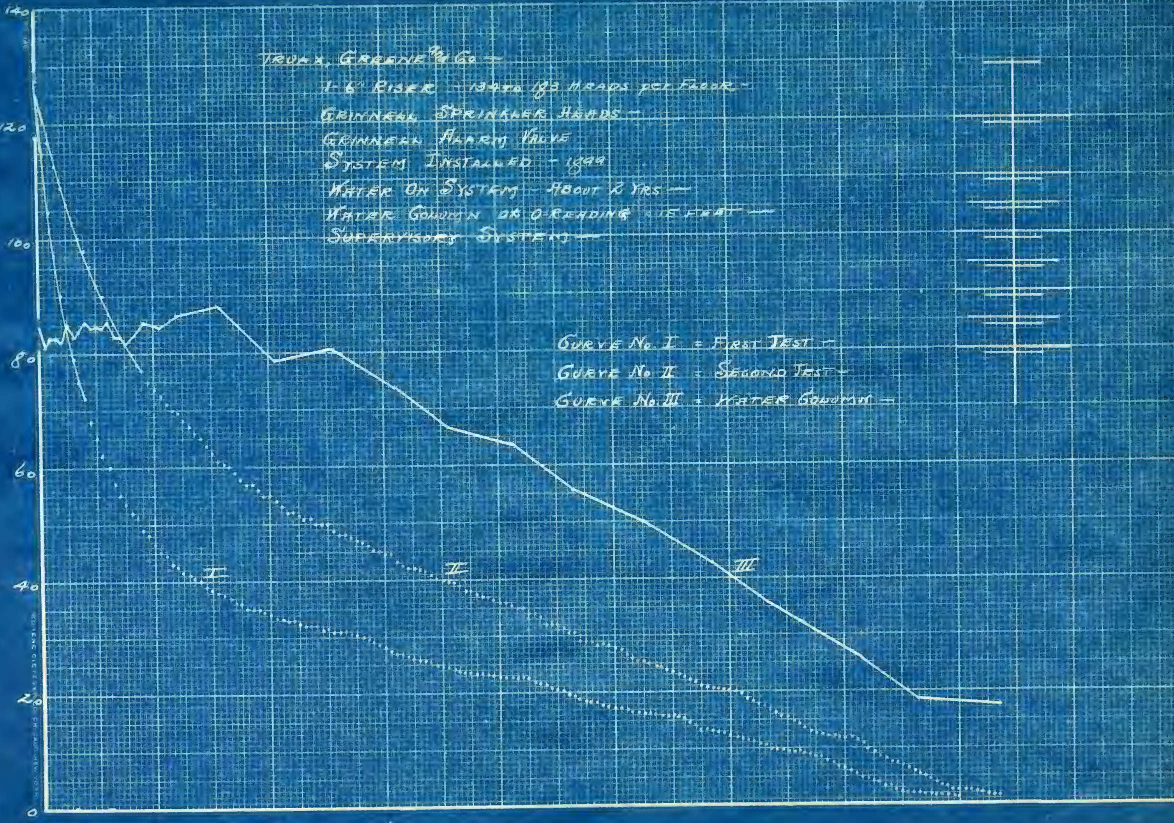
Water Column at 0-Reading = 10.5 Ft —

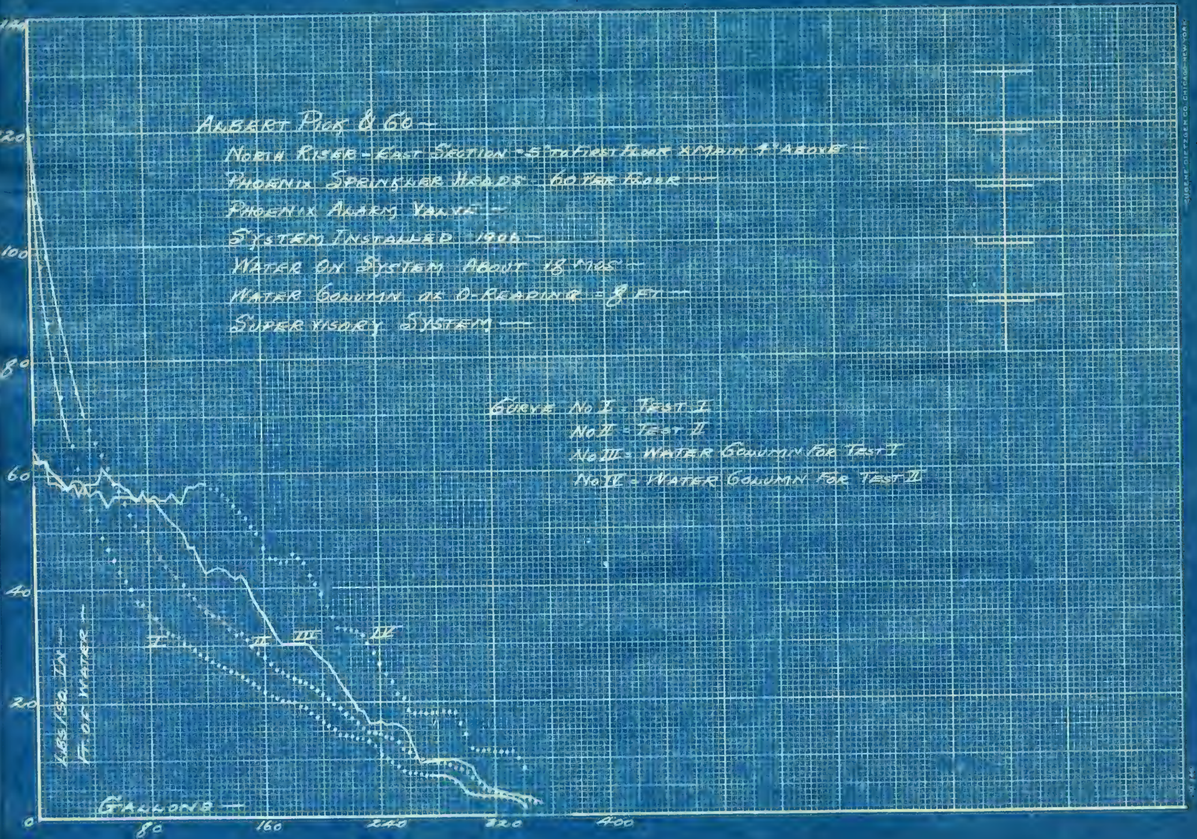
Supervisory System —

Curve No I = Test I

No II = Test II

No III = Water Column —


TRUAX, GREENE & Co —
1-6" RISER 134 to 183 HEADS per FLOOR —
GRINNELL SPRINKLER HEADS —
GRINNELL ALARM VALVE
SYSTEM INSTALLED — 1899
WATER ON SYSTEM — ABOUT 2 YRS —
WATER COLUMN OR 0-READING IS 15 FEET —
SUPERVISORY SYSTEM —
CURVE No. I = FIRST TEST —
CURVE No. II = SECOND TEST —
CURVE No. III = WATER COLUMN —
I
II
III
140
120
100
80
60
40
20
0



Albert Pick & Co —

North Riser - East Section - 5" to First Floor & Main 4" Above —

Phoenix Sprinkler Heads 60 Per Floor —

Phoenix Alarm Valve —

System Installed 1906 —

Water on System About 18 Mos —

Water Column at 0-Reading = 8 Ft —

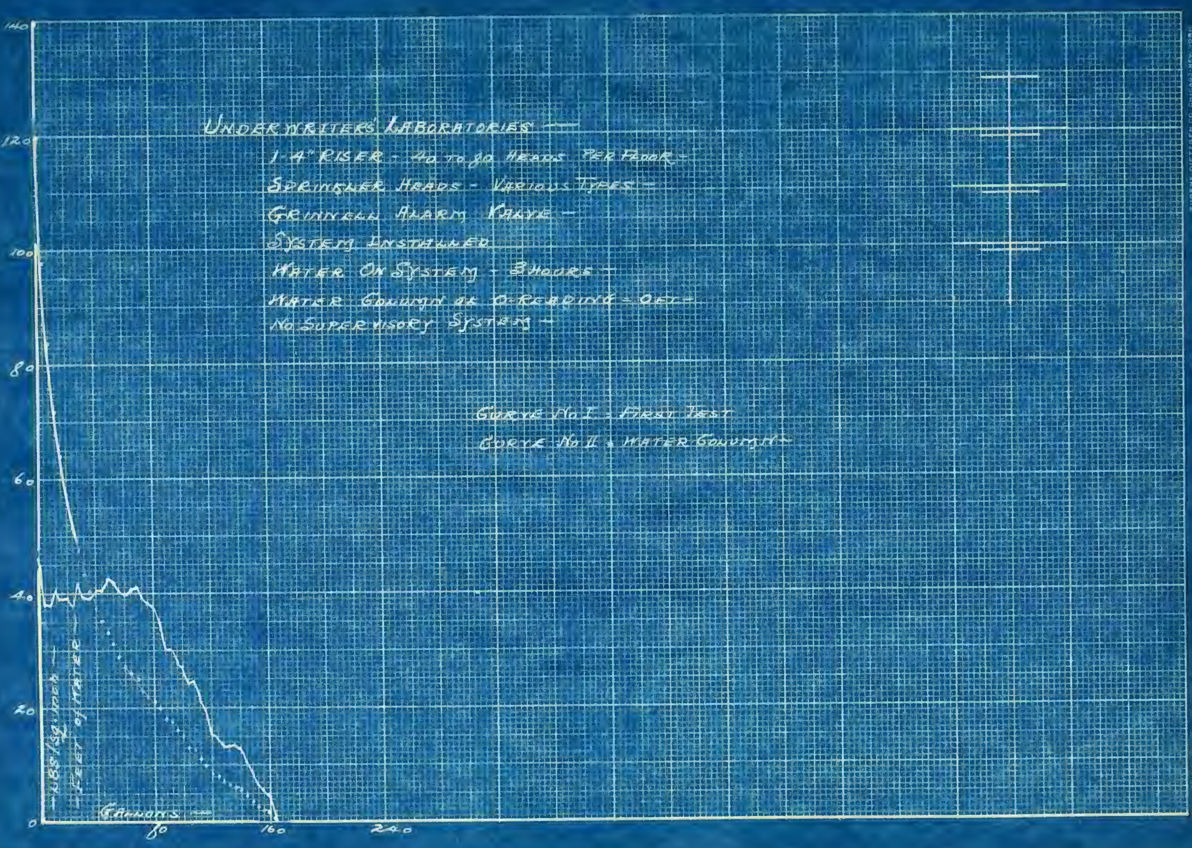
Supervisory System —

Curve No I - Test I

No II - Test II

No III - Water Column for Test I

No IV - Water Column for Test II



UNDERWRITERS' LABORATORIES —

1 - 4" RISER - 40 TO 90 HEADS PER FLOOR -

SPRINKLER HEADS - VARIOUS TYPES -

GRINNELL ALARM VALVE -

SYSTEM INSTALLED

WATER ON SYSTEM - 3 HOURS -

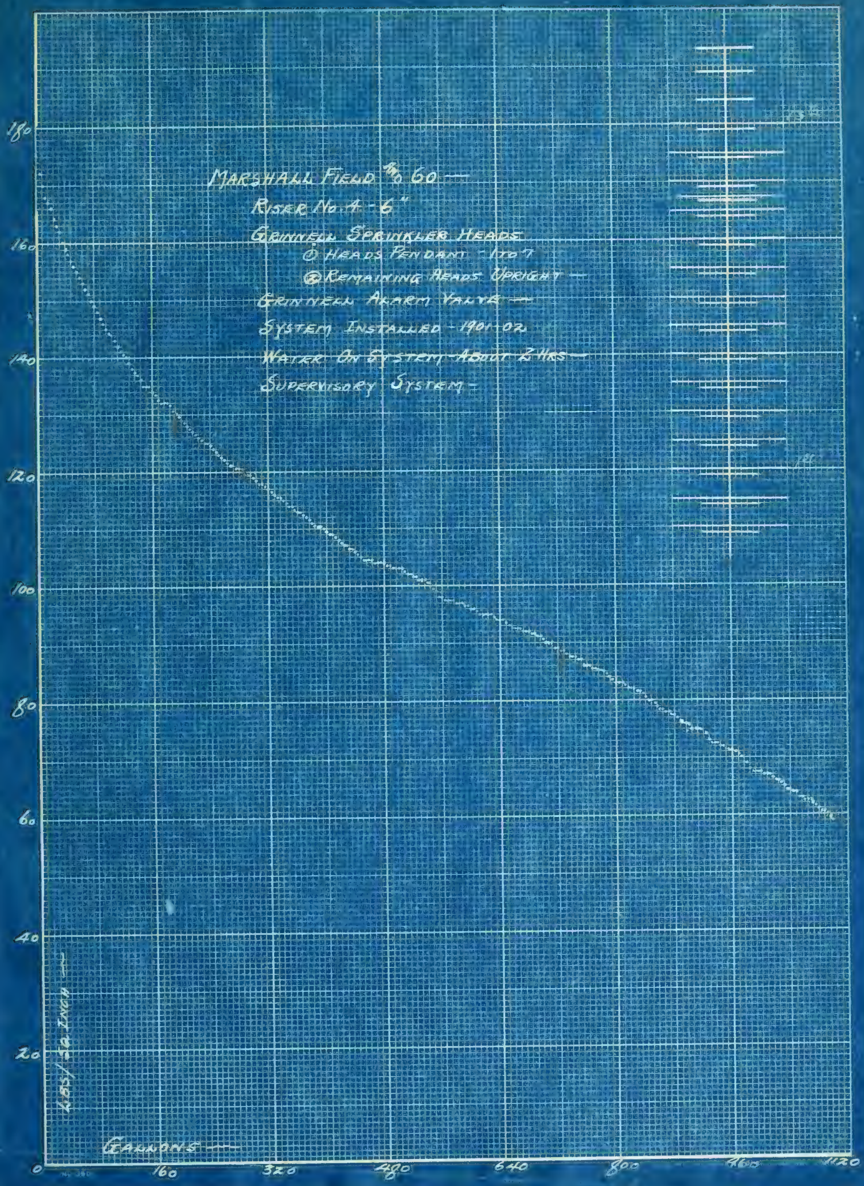
WATER COLUMN AT 0 READING = 0 FT -

NO SUPERVISORY SYSTEM -

CURVE NO I - FIRST TEST

CURVE NO II - WATER COLUMN -

EUGENE DIETZGEN CO. CHICAGO-NEW YORK



MARSHALL FIELD No 60 —

RISER No. 4 - 6"

GRINNELL SPRINKLER HEADS

① HEADS PENDANT - 1 TO 7

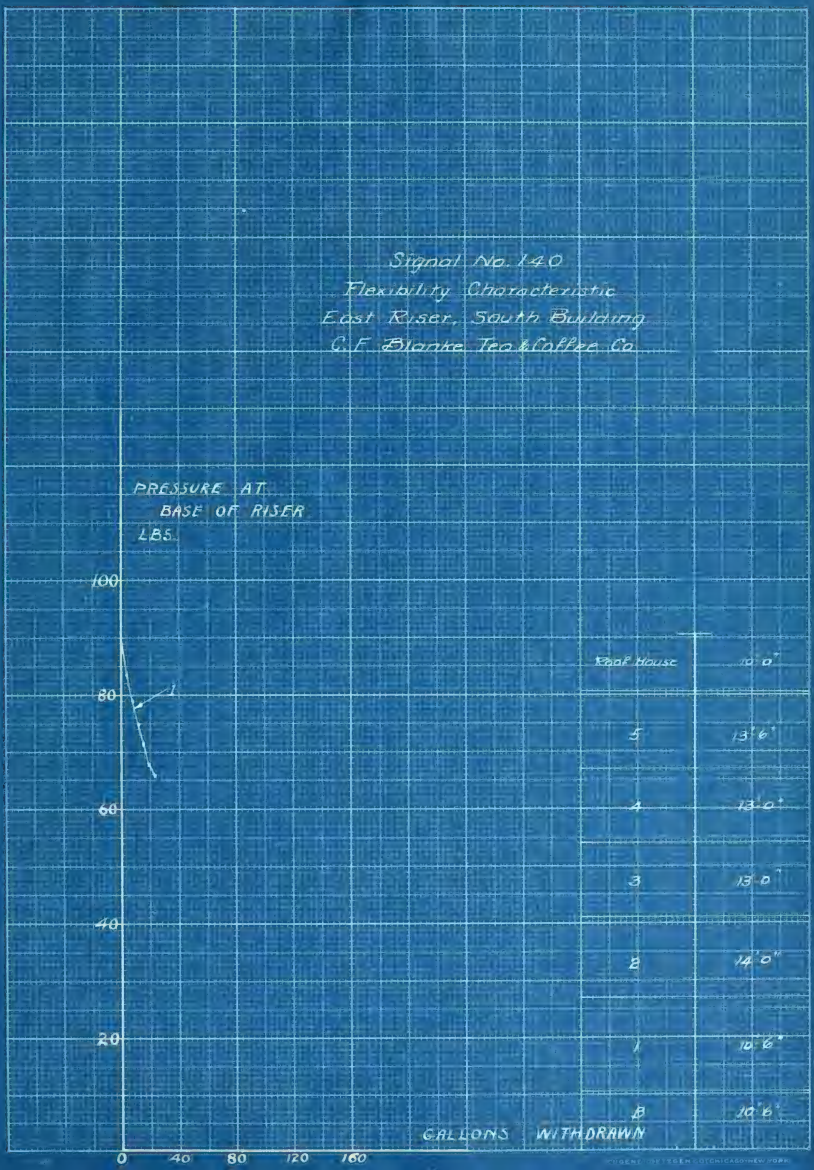
② REMAINING HEADS UPRIGHT —

GRINNELL ALARM VALVE —

SYSTEM INSTALLED - 1901 - 02

WATER ON SYSTEM ABOUT 2 HRS —

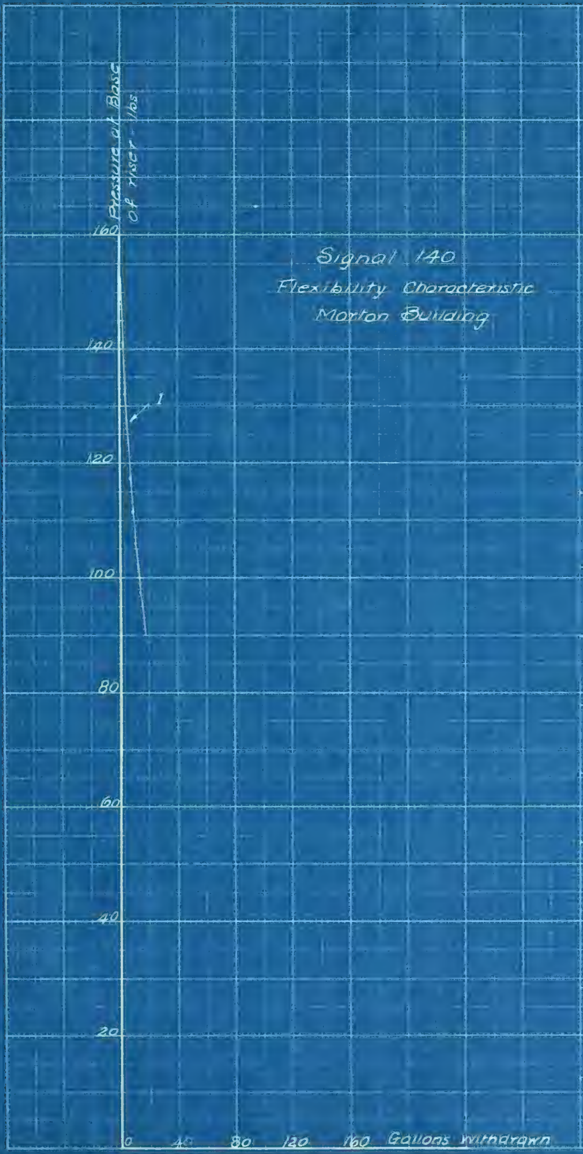
SUPERVISORY SYSTEM —



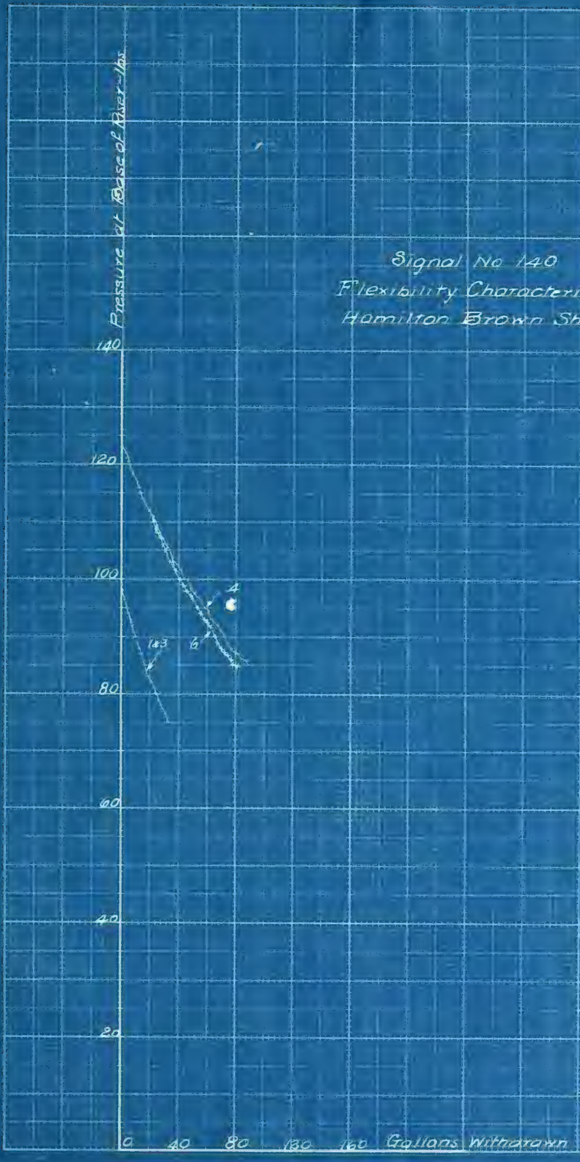
Signal No. 140
Flexibility Characteristic
East Riser, South Building
C. F. Blanke Tea & Coffee Co.

Roof House	10' 0"
5	13' 6"
4	13' 0"
3	13' 0"
2	14' 0"
1	10' 6"
B	10' 6"

EUGENE DIETZGEN CO. CHICAGO-NEW YORK

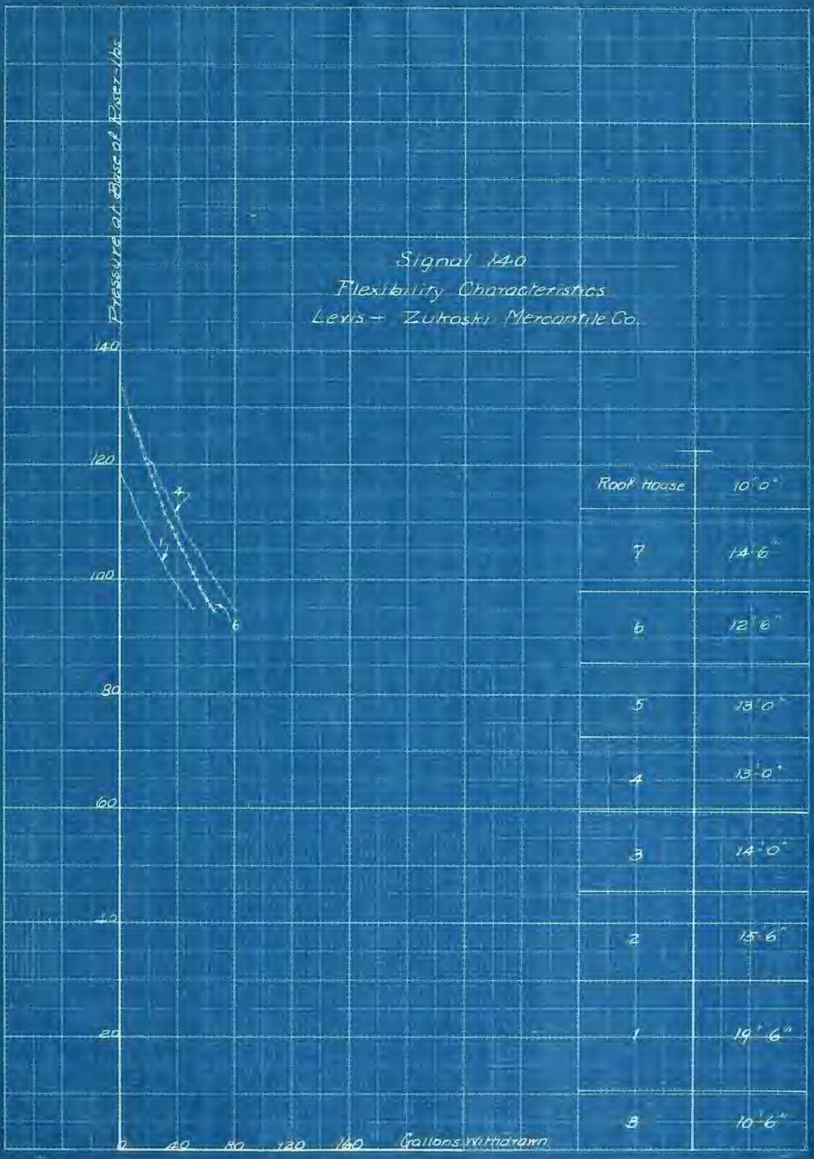

Signal 140
Flexibility Characteristic
Morton Building

Roof House	10'0"
8	13'0"
7	12'0"
6	12'0"
5	12'0"
4	12'0"
3	12'0"
2	13'6"
1	15'9"
B	12'6"



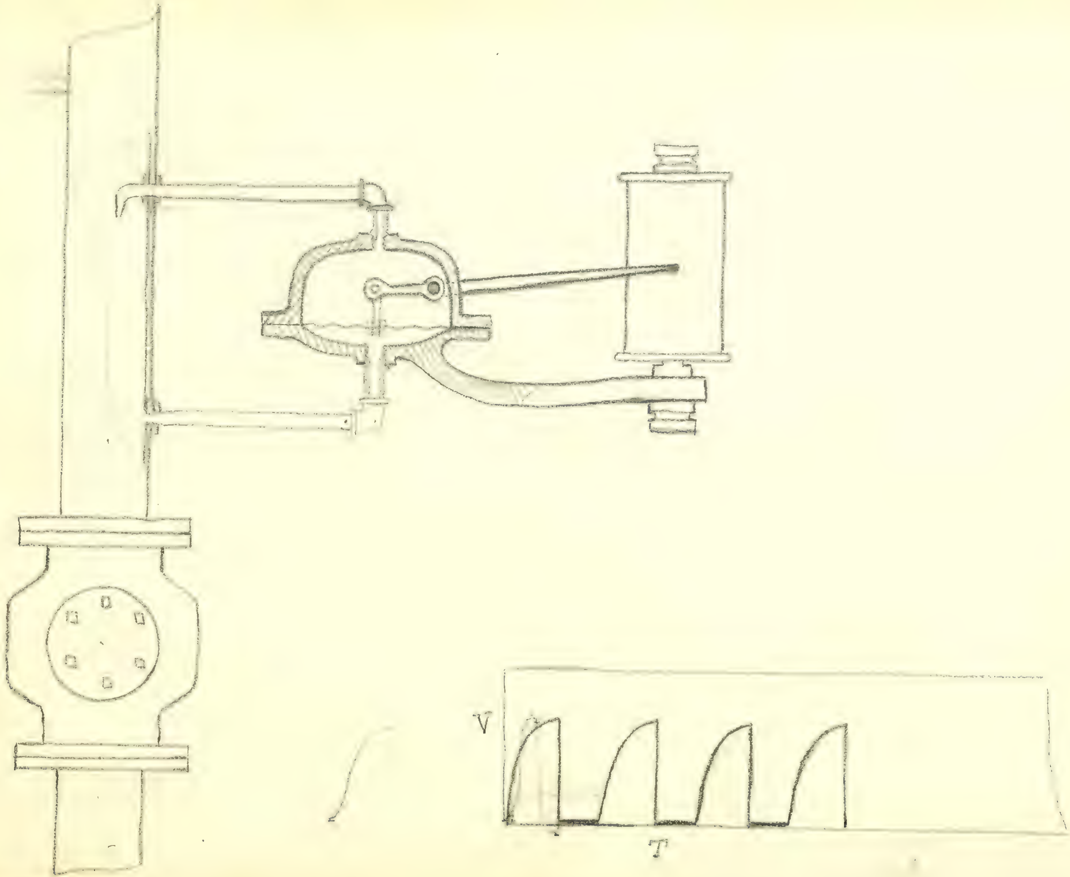
Signal No 140
Flexibility Characteristics
Hamilton Brown Shoe Co.

Roof House	10' 0"
7	10' 0"
6	10' 6
5	11' 10"
4	12' 3
3	12' 4"
2	13' 3"
1	14' 6"
B	10' 6"

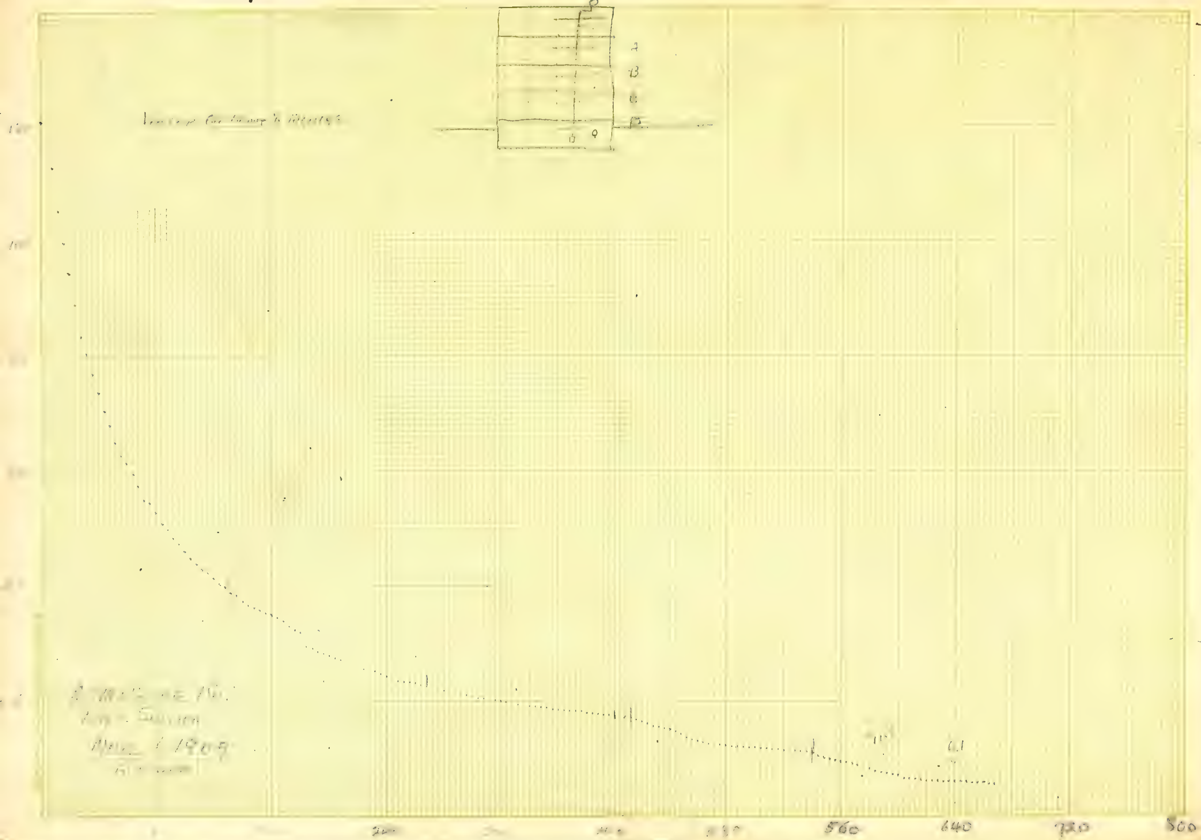


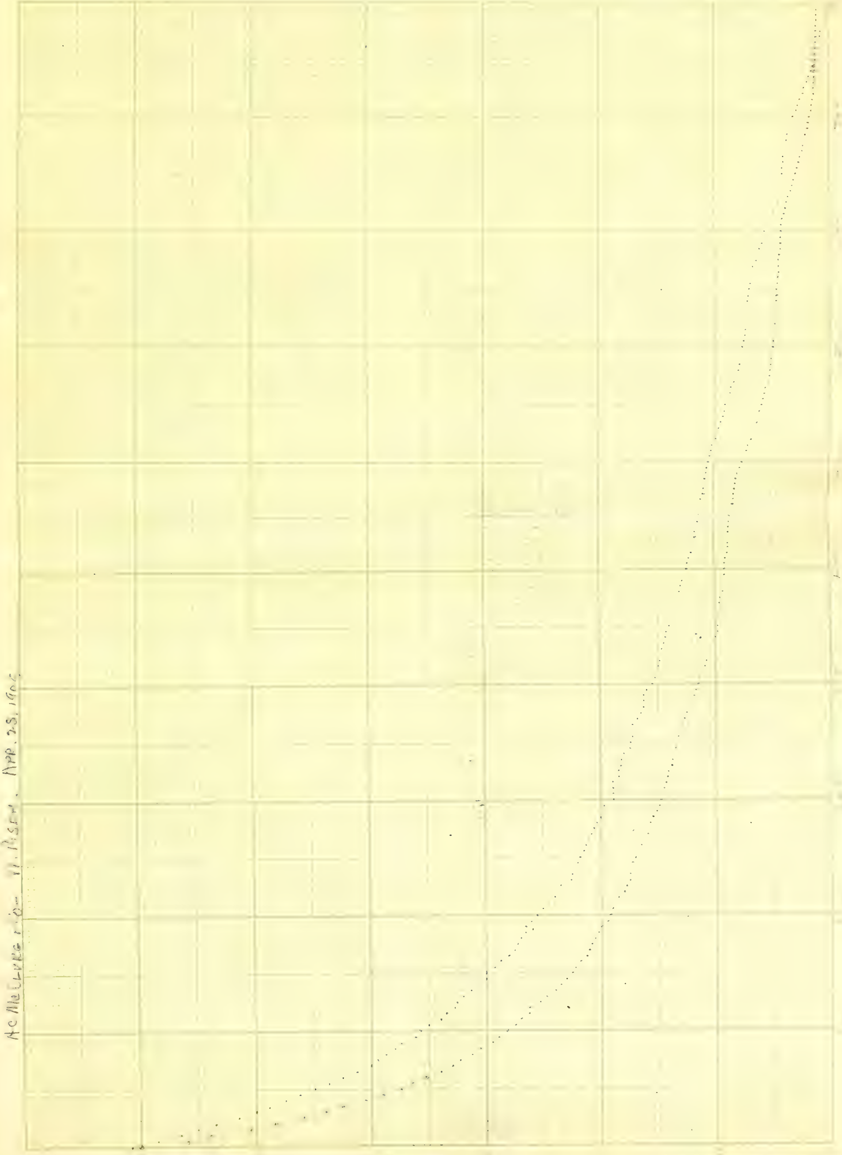
Signal 140
Flexibility Characteristics
Lewis — Zukoski Mercantile Co.

Roof House	10' 0"
7	14' 6"
6	12' 6"
5	13' 0"
4	13' 0"
3	14' 0"
2	15' 6"
1	19' 6"
B	10' 6"

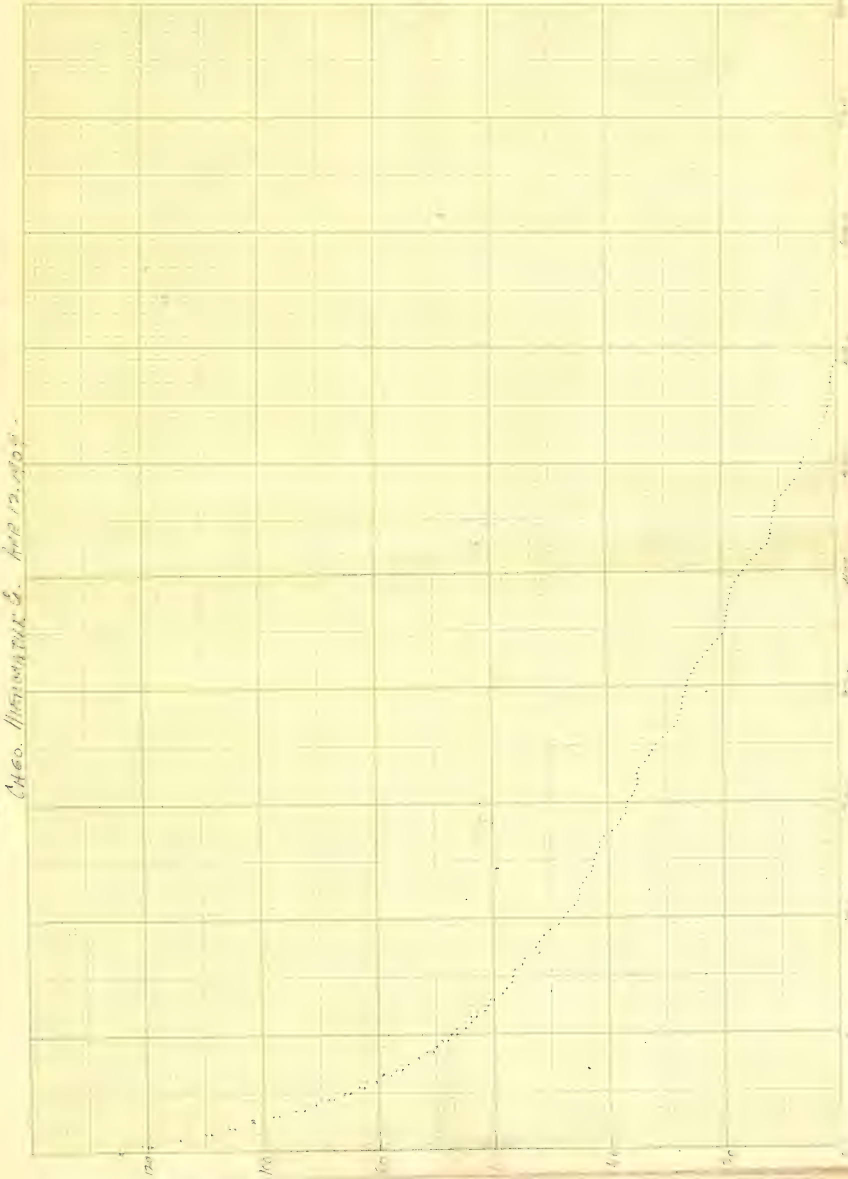

V
T

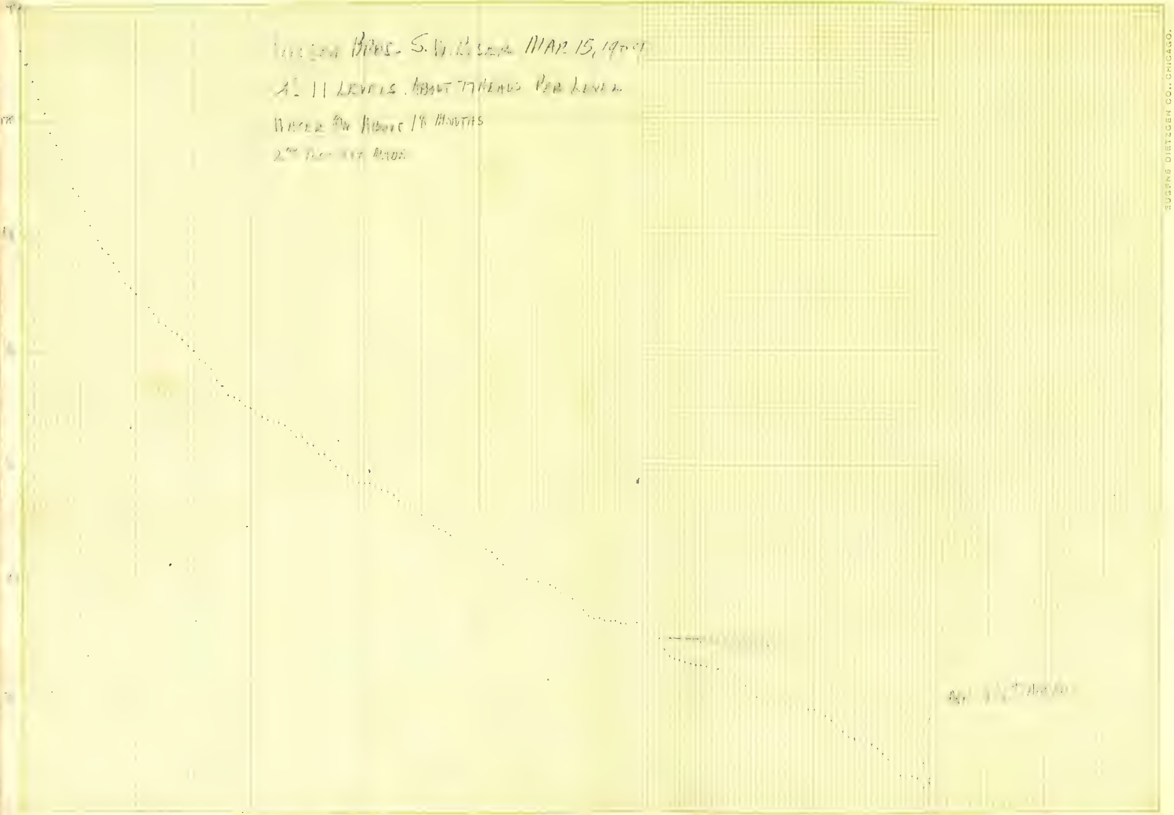
12
2
4
19
6
114




HC MeLLVRG · O– 11. P.SEM. APP. 25, 1906

H.G. Stevens – 3rd. Apr 19, [illegible]


CHGO. HIAWATHA S. APR 13, 1905.
120
100



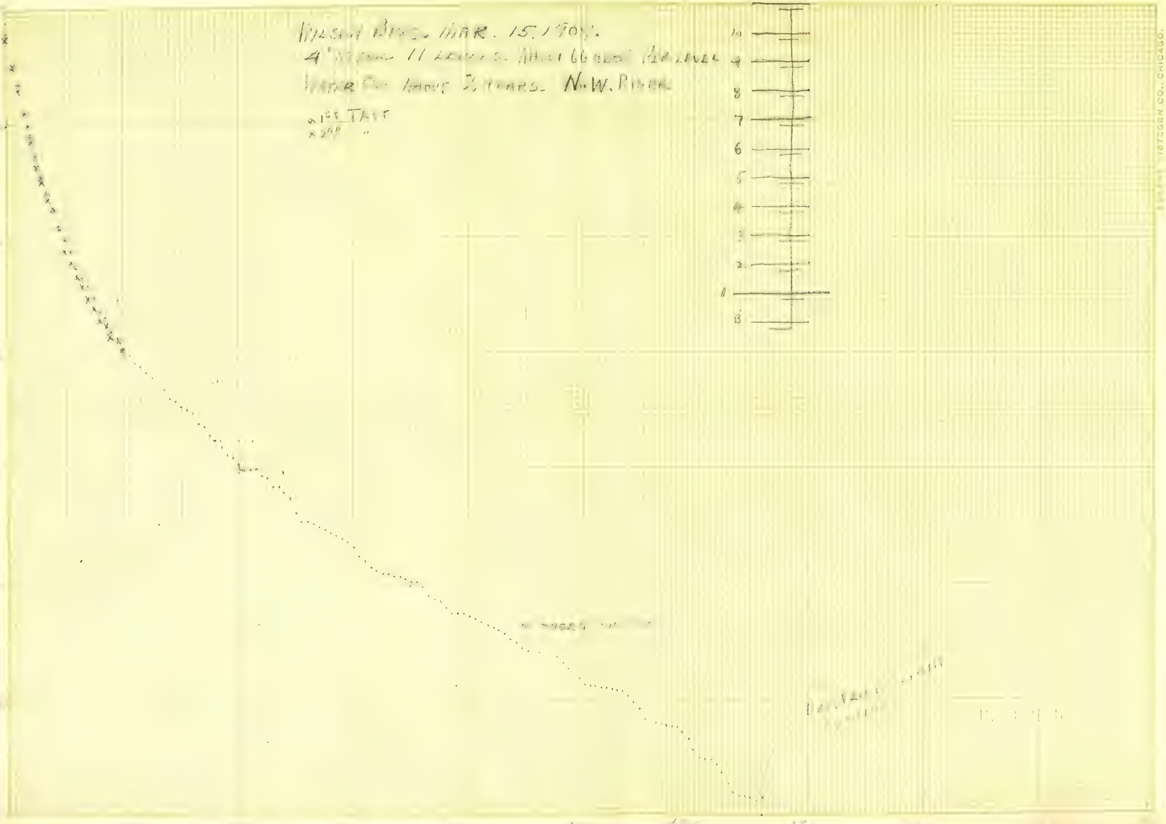
[illegible] BROS. - S.W. [illegible] MAR 15, 190[illegible]

A. 11 LEVELS. ABOUT 77 HEADS PER LEVEL

WATER ON ABOUT 18 MONTHS

2ND [illegible] [illegible] MADE

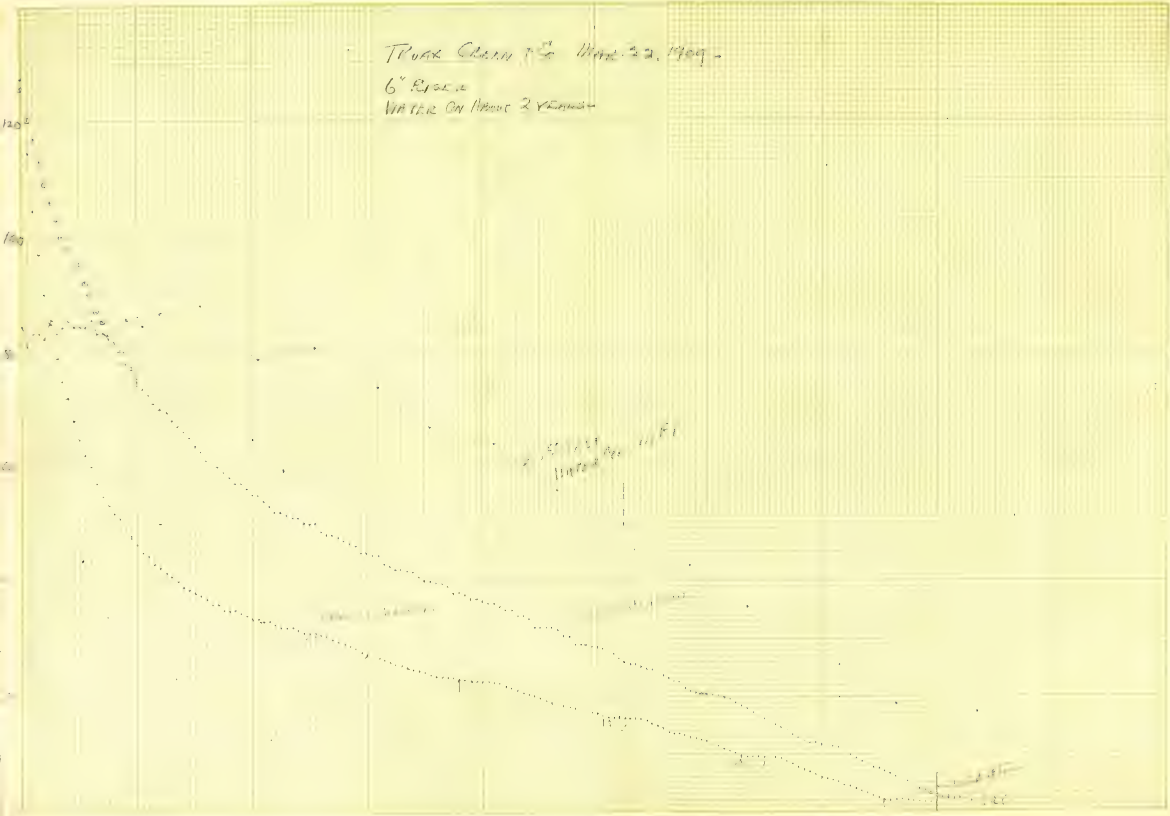
[illegible]



Wilson Bros. Mar. 15, 1904.
4" [illegible] 11 Leaves. About 66 feet Parallel
Water On about 2 years. N.W. River

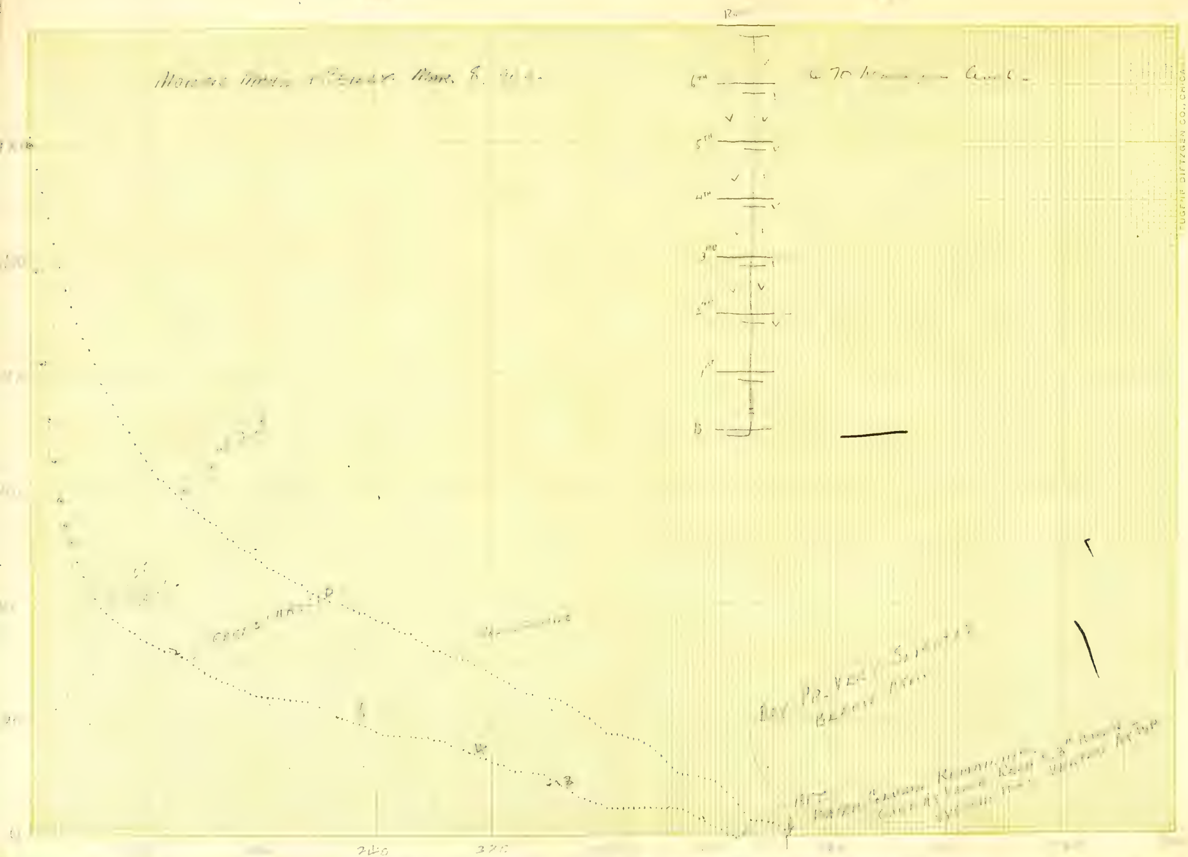
○ 1st Test
× 2nd "

EUGENE DIETZGEN CO., CHICAGO.

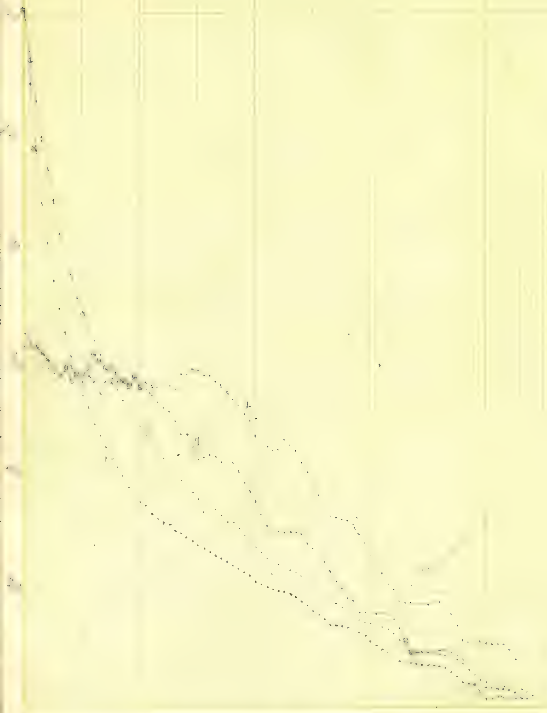


TRUAX CLEAN 1st MAR. 22, 1954 -
6" RISER
WATER ON ABOUT 2 YEARS -

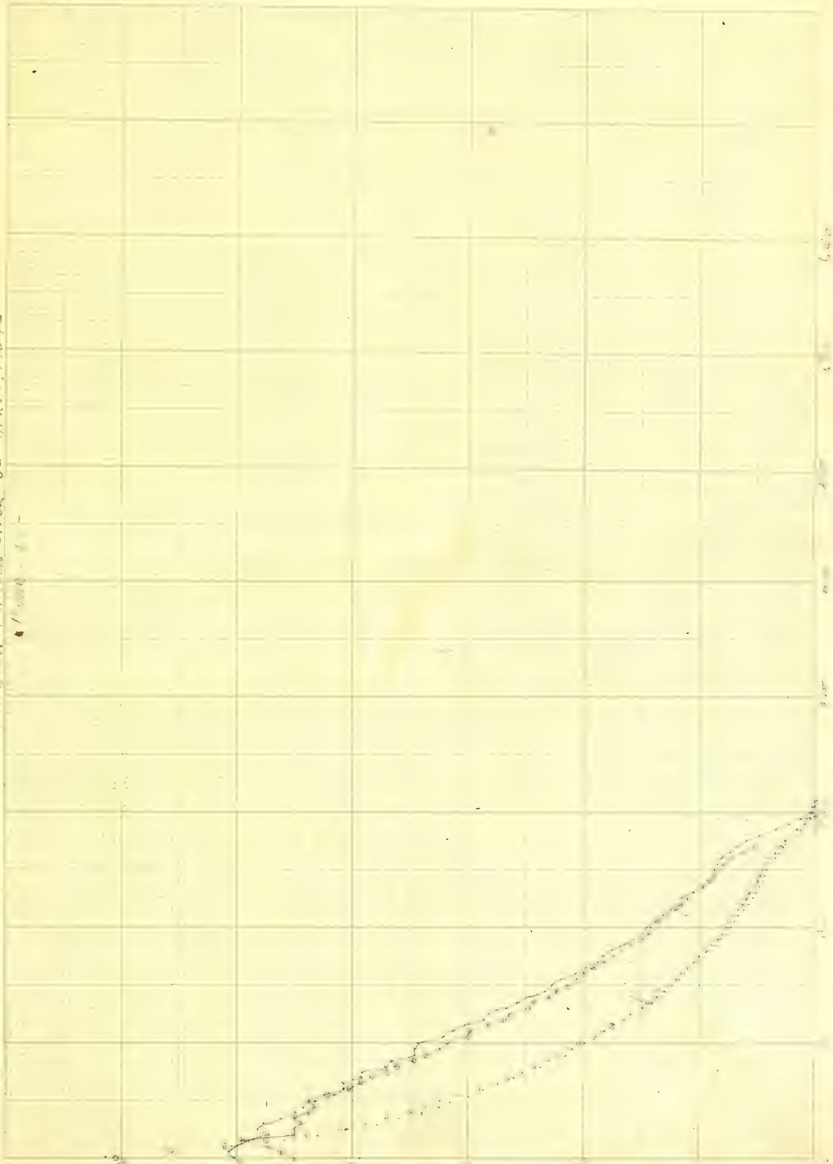
EUGENE DIETZGEN CO., CHICAGO.

R
6TH
5TH
4TH
3RD
2ND
1ST
B
240
320

Azimuth Plot / Co. H. [illegible] E [illegible]



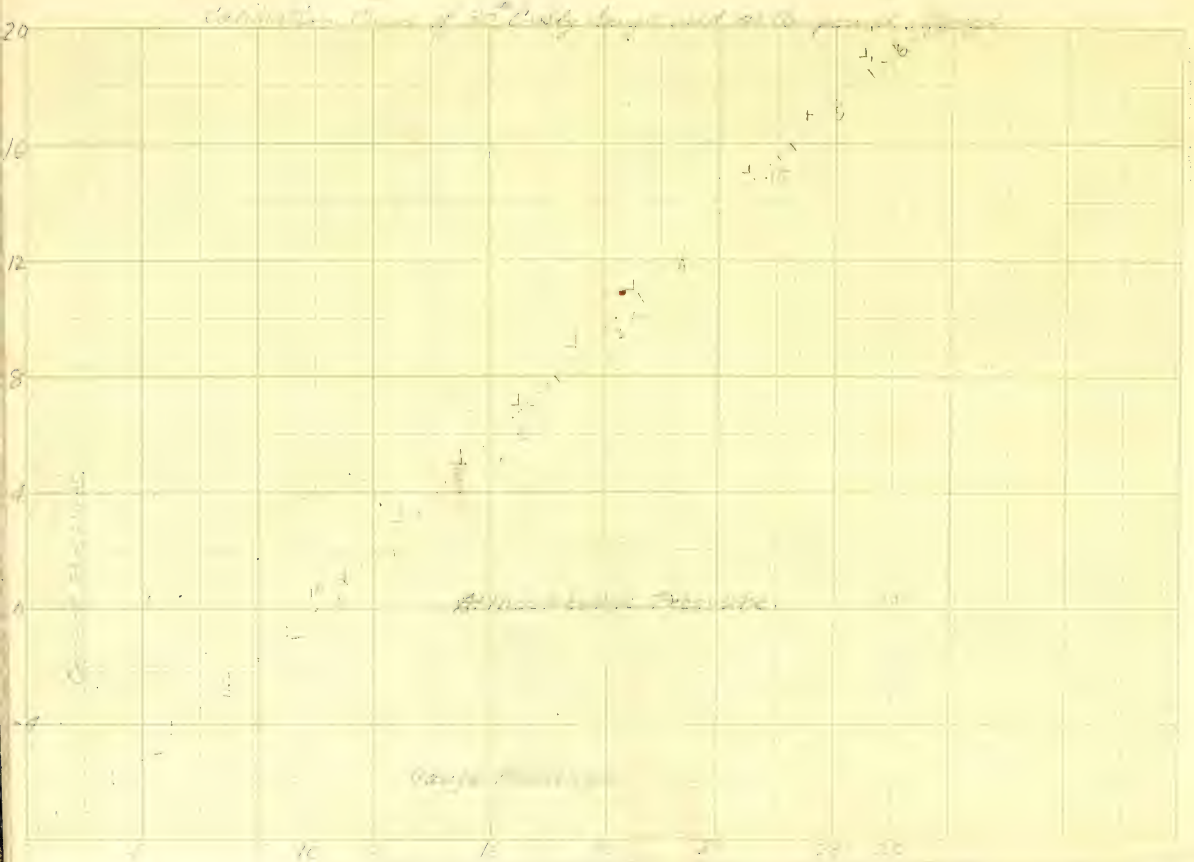
E. GENE ETZGEN CO. CHICAGO.

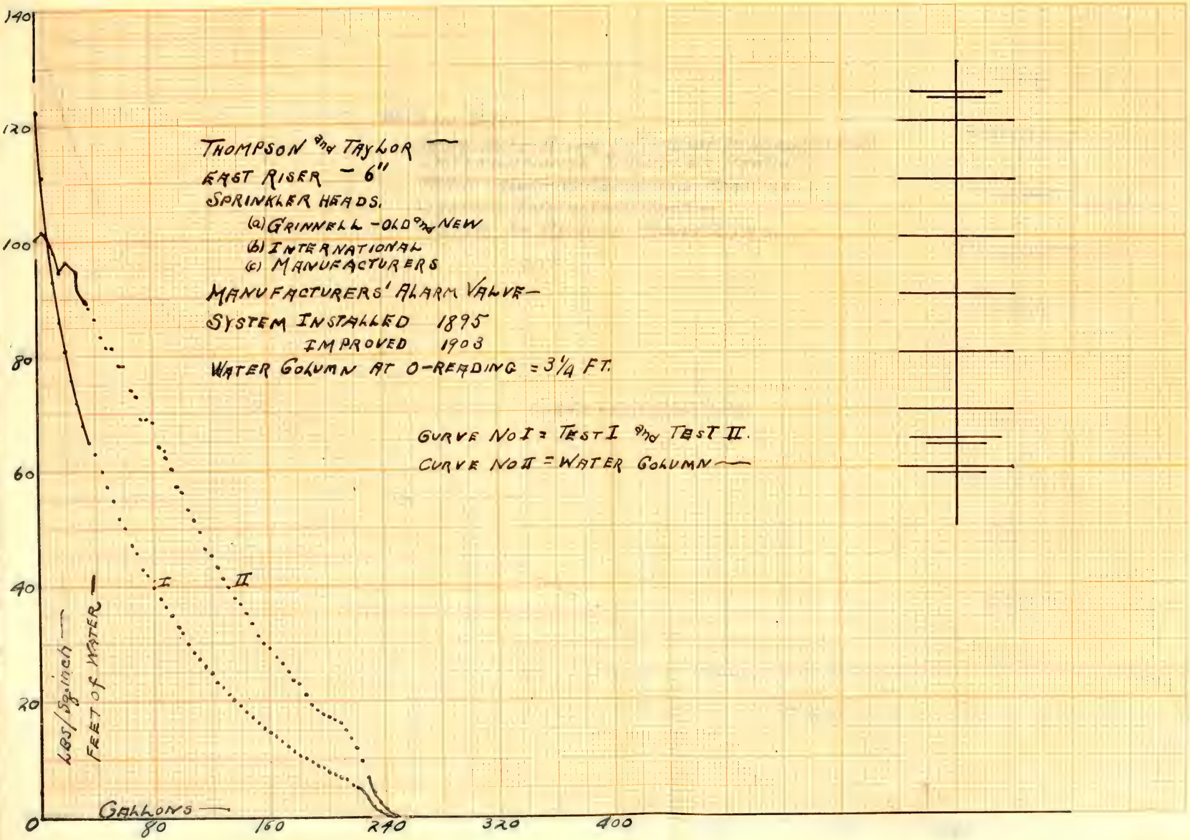


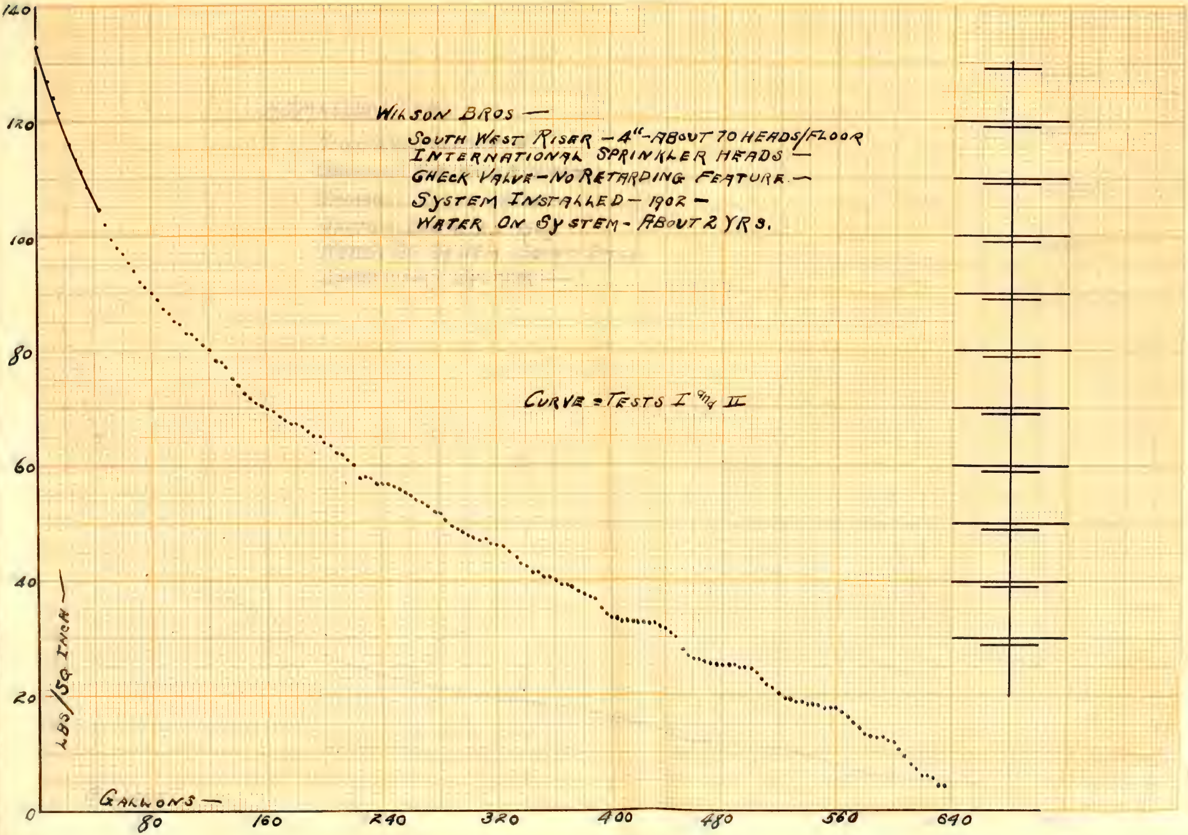
Thompson & Taylor Spice Co. Apr. 5, 1909.

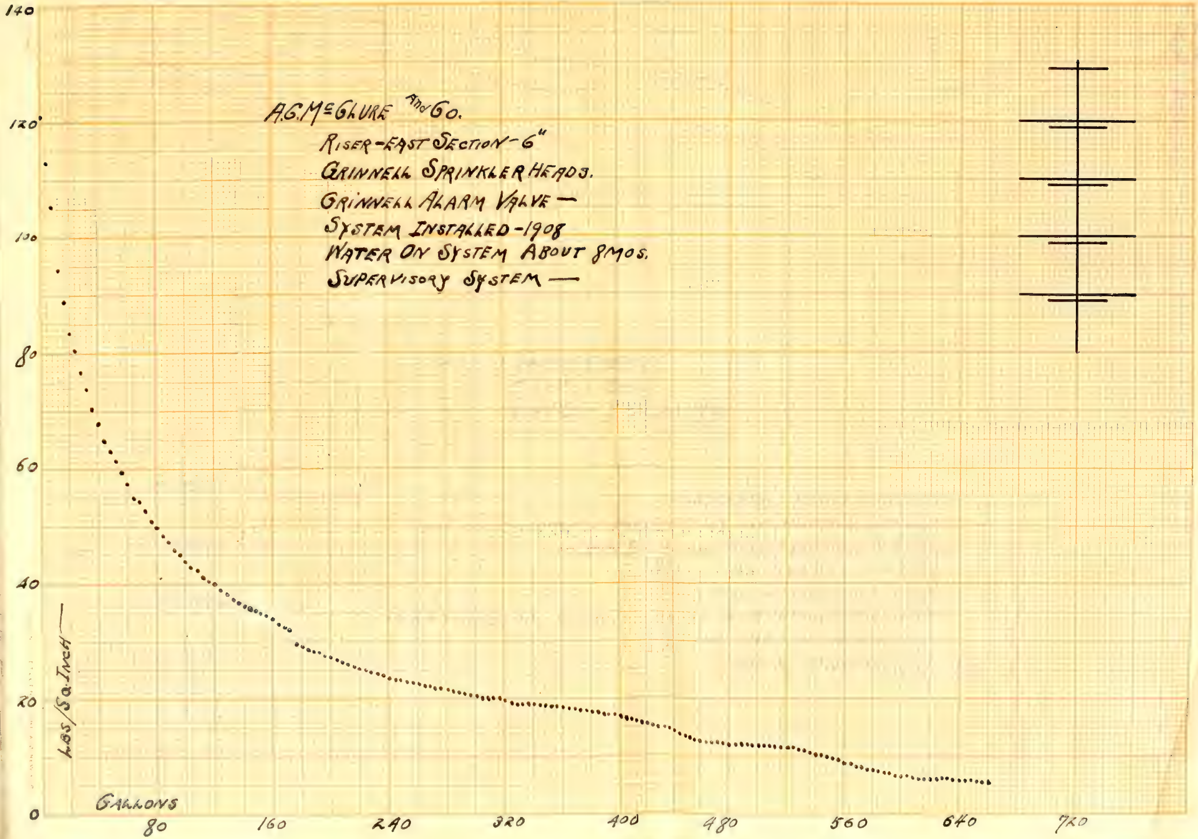
[illegible]

171

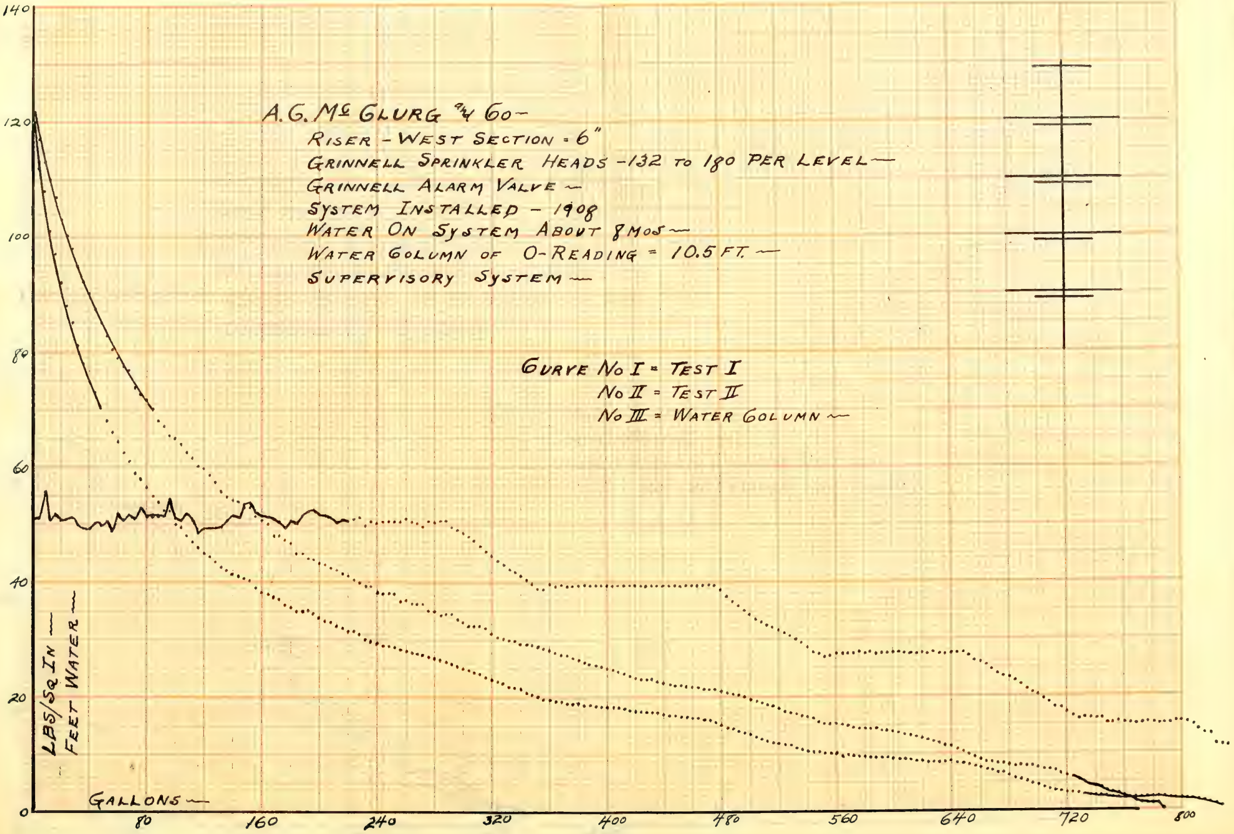



THOMPSON and TAYLOR —
EAST RISER — 6"
SPRINKLER HEADS.
(a) GRINNELL - OLD and NEW
(b) INTERNATIONAL
(c) MANUFACTURERS
MANUFACTURERS' ALARM VALVE —
SYSTEM INSTALLED 1895
IMPROVED 1903
WATER COLUMN AT 0-READING = 3¼ FT.
CURVE No I = TEST I and TEST II.
CURVE No II = WATER COLUMN —
I
II
LBS/Sq. inch —
FEET of WATER —
GALLONS —
0
20
40
60
80
100
120
140
80
160
240
320
400


WILSON BROS —
SOUTH WEST RISER — 4" — ABOUT 70 HEADS/FLOOR
INTERNATIONAL SPRINKLER HEADS —
CHECK VALVE — NO RETARDING FEATURE —
SYSTEM INSTALLED — 1902 —
WATER ON SYSTEM — ABOUT 2 YRS.
CURVE = TESTS I and II
LBS/SQ INCH —
GALLONS —
140
120
100
80
60
40
20
0
80
160
240
320
400
480
560
640



A.G. McGlure and Go.
Riser-East Section-6"
Grinnell Sprinkler Heads.
Grinnell Alarm Valve —
System Installed-1908
Water on System About 8 mos.
Supervisory System —



A.G. McClurg & Co—

Riser - West Section = 6"

Grinnell Sprinkler Heads - 132 to 180 per Level—

Grinnell Alarm Valve ~

System Installed - 1908

Water on System about 8 Mos~

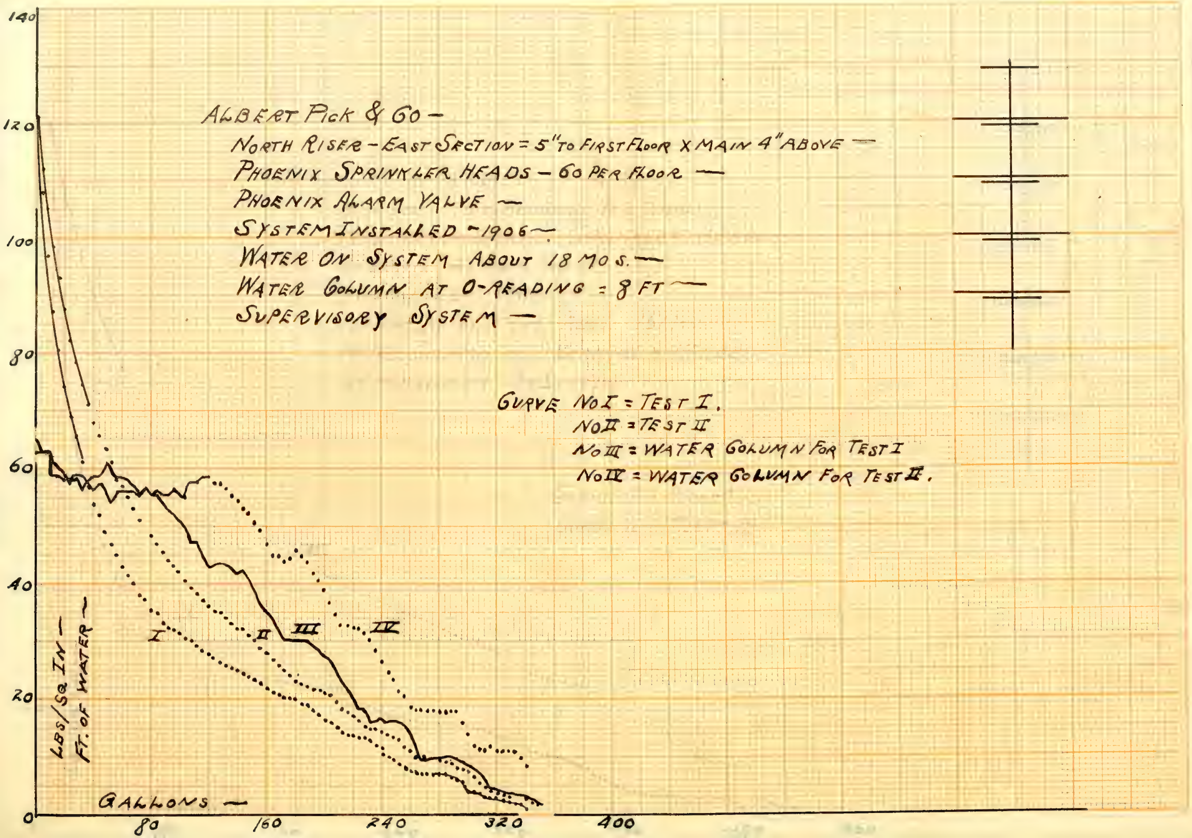
Water Column of 0-Reading = 10.5 FT.—

Supervisory System—

Curve No I = Test I

No II = Test II

No III = Water Column ~



ALBERT PICK & CO –

NORTH RISER – EAST SECTION = 5" TO FIRST FLOOR X MAIN 4" ABOVE –

PHOENIX SPRINKLER HEADS – 60 PER FLOOR –

PHOENIX ALARM VALVE –

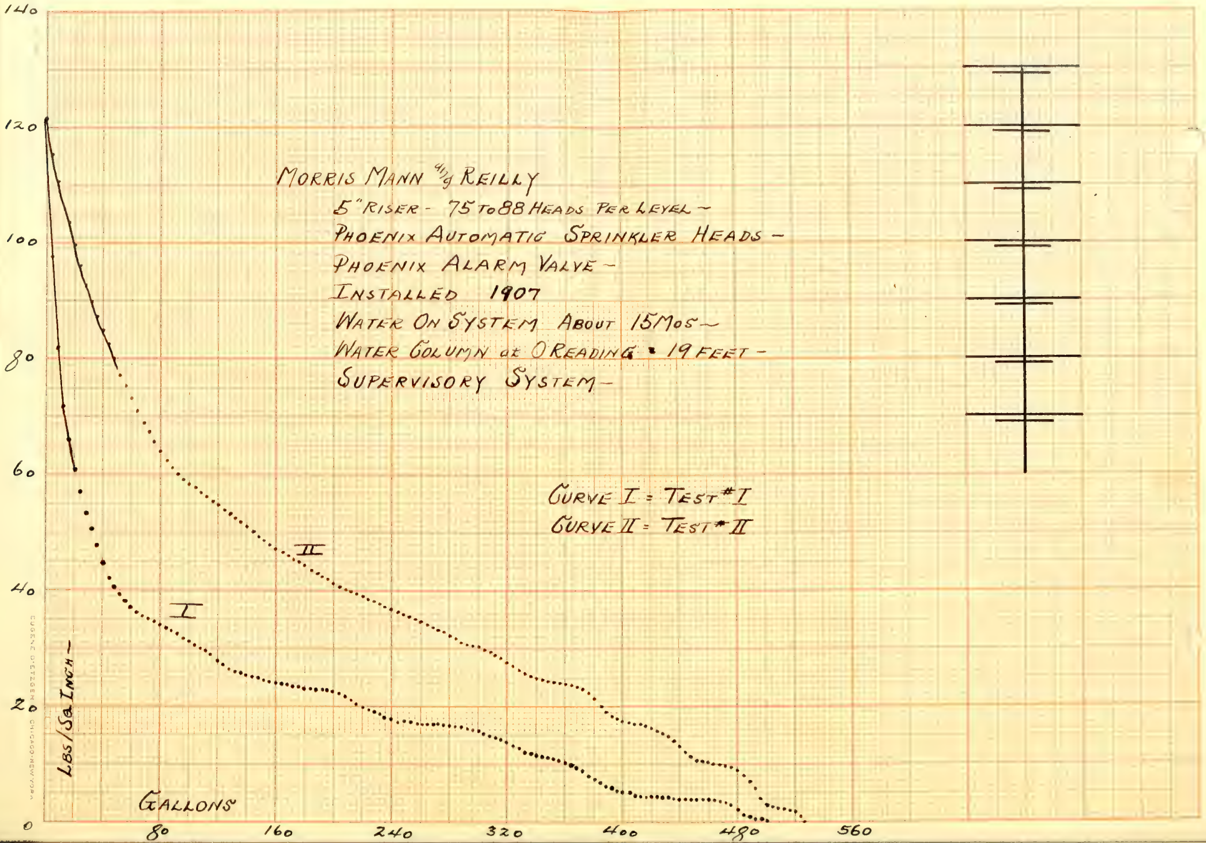
SYSTEM INSTALLED – 1906 –

WATER ON SYSTEM ABOUT 18 MOS. –

WATER COLUMN AT 0-READING = 8 FT –

SUPERVISORY SYSTEM –

CURVE No I = TEST I.
No II = TEST II
No III = WATER COLUMN FOR TEST I
No IV = WATER COLUMN FOR TEST II.



MORRIS MANN 4/17/9 REILLY

5" RISER - 75 TO 88 HEADS PER LEVEL –

PHOENIX AUTOMATIC SPRINKLER HEADS –

PHOENIX ALARM VALVE –

INSTALLED 1907

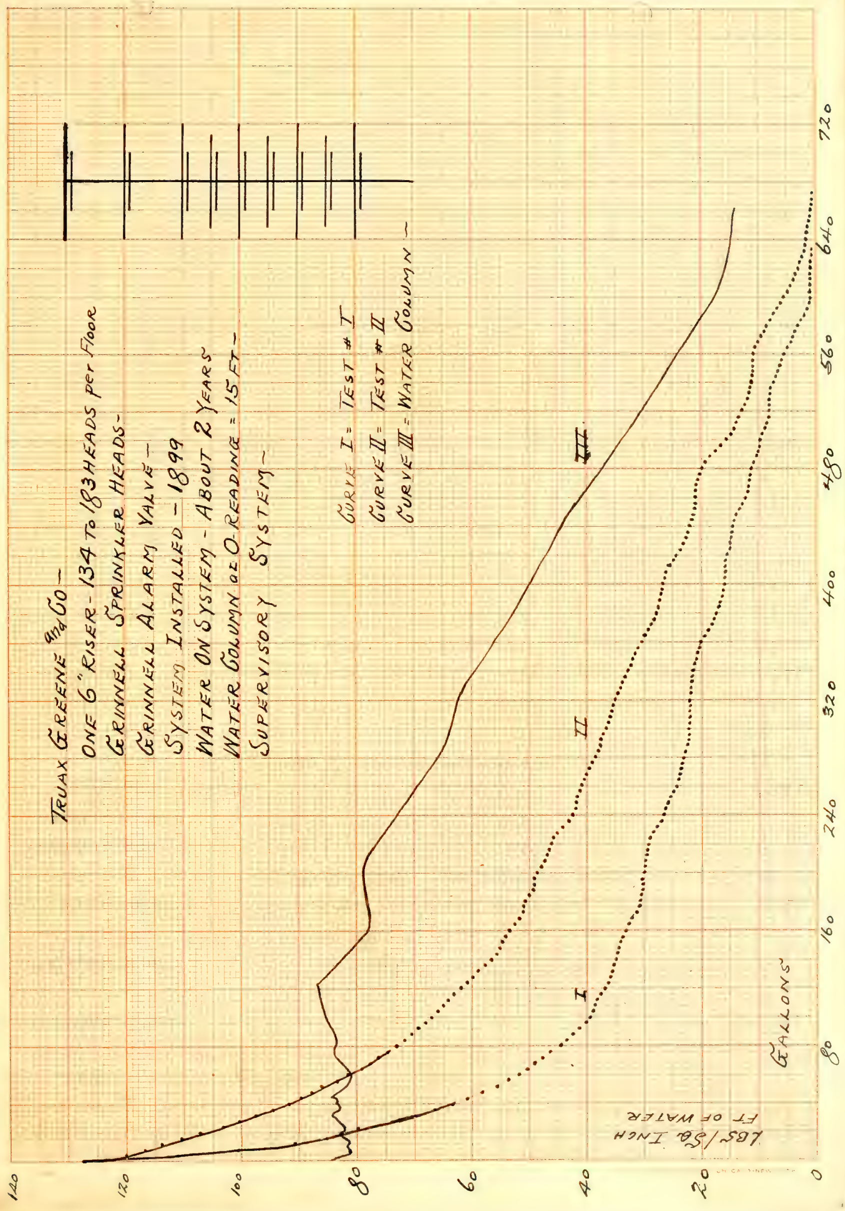
WATER ON SYSTEM ABOUT 15 MOS –

WATER COLUMN at 0 READING = 19 FEET –

SUPERVISORY SYSTEM –

CURVE I = TEST # I

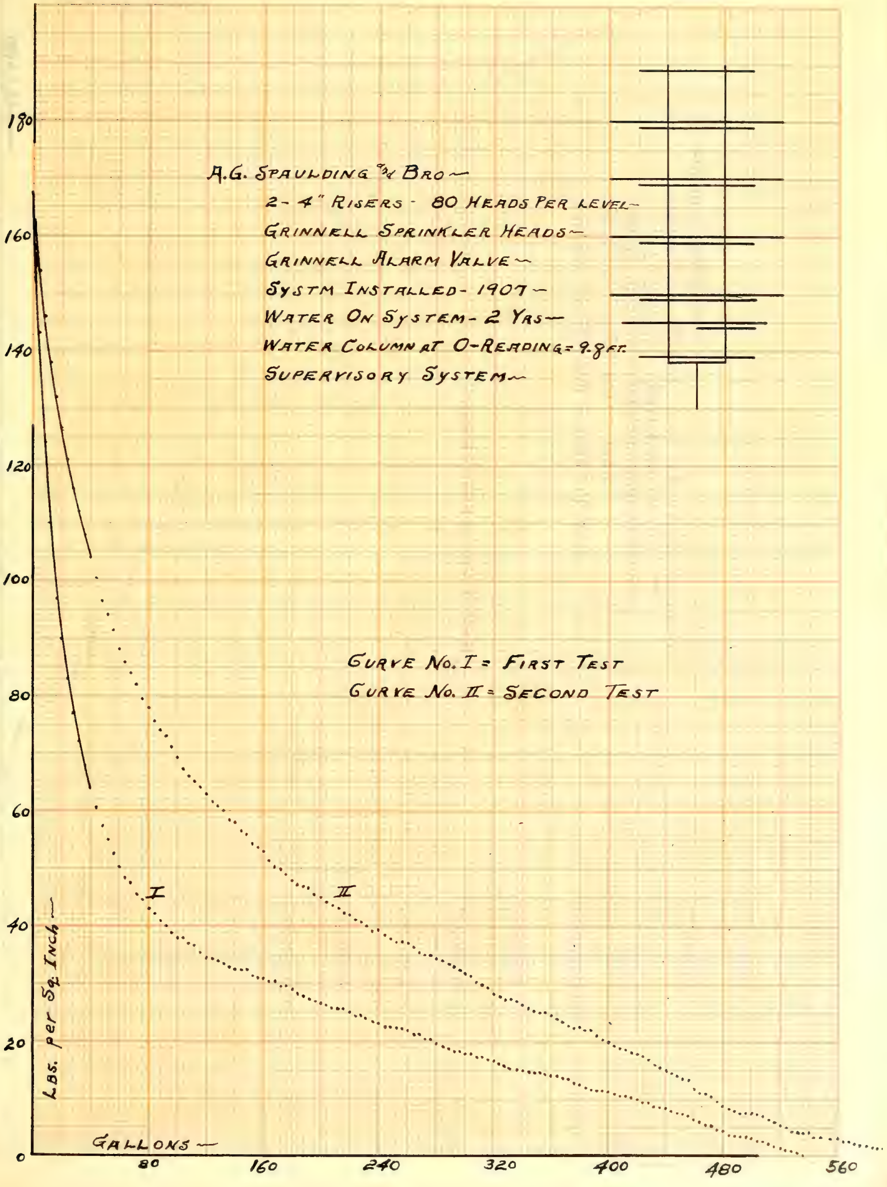
CURVE II = TEST # II



Truax Greene and Co—

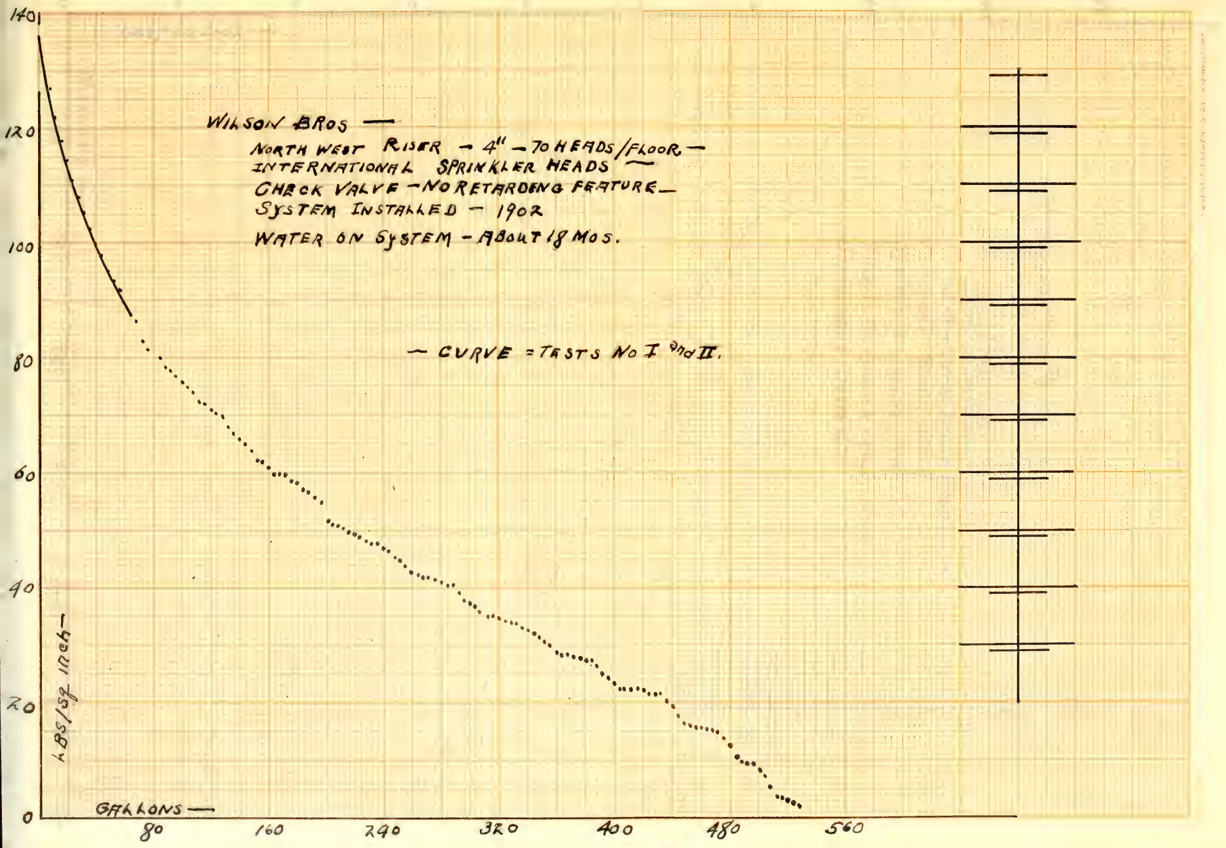
One 6" Riser - 134 to 183 Heads per Floor
Grinnell Sprinkler Heads -
Grinnell Alarm Valve -
System Installed - 1899
Water On System - About 2 Years
Water Column at O-Reading = 15 Ft -
Supervisory System -

Curve I = Test # I
Curve II = Test # II
Curve III = Water Column -



A.G. SPAULDING & BRO ~
2 - 4" RISERS - 80 HEADS PER LEVEL ~
GRINNELL SPRINKLER HEADS ~
GRINNELL ALARM VALVE ~
SYSTM INSTALLED - 1907 ~
WATER ON SYSTEM - 2 YRS —
WATER COLUMN AT 0-READING = 9.8 FT.
SUPERVISORY SYSTEM ~

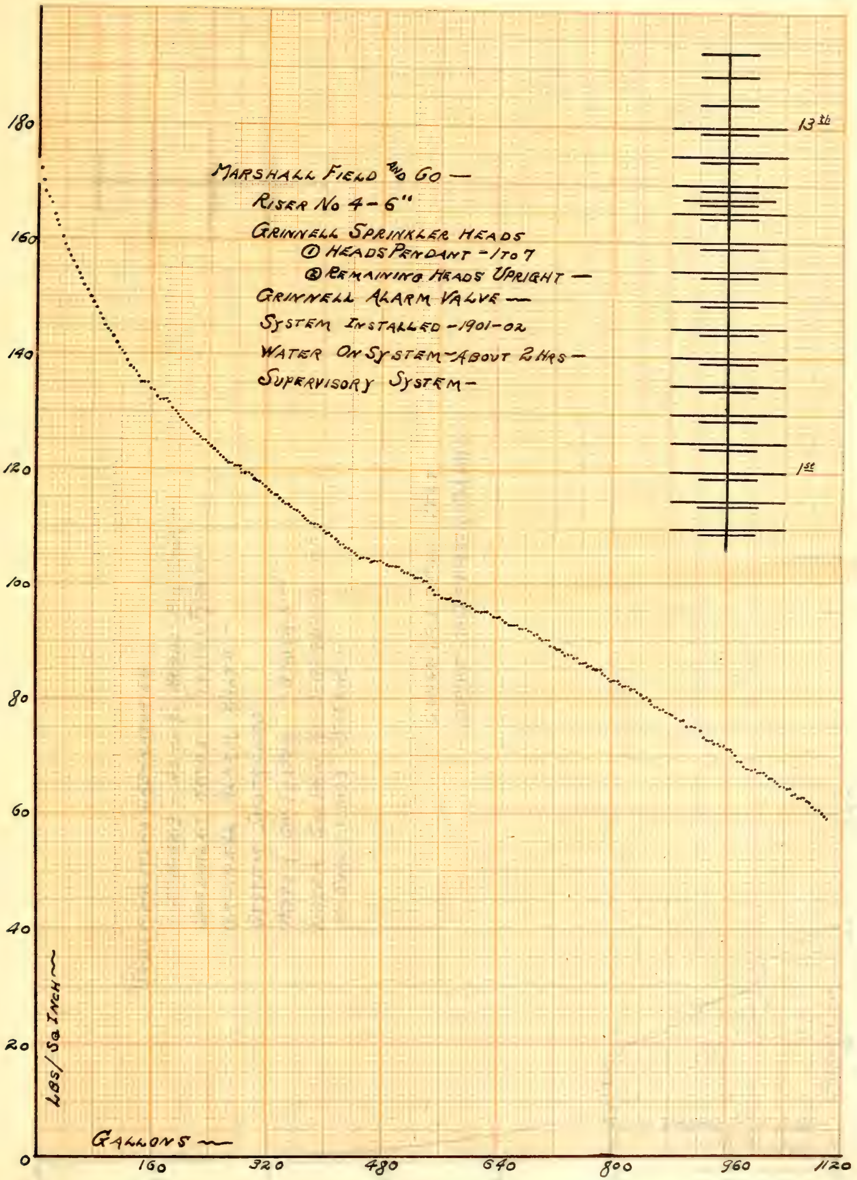
CURVE No. I = FIRST TEST
CURVE No. II = SECOND TEST



WILSON BROS —

NORTH WEST RISER – 4" – 70 HEADS/FLOOR –
INTERNATIONAL SPRINKLER HEADS —
CHECK VALVE – NO RETARDING FEATURE –
SYSTEM INSTALLED – 1902
WATER ON SYSTEM – ABOUT 18 MOS.

– CURVE = TESTS NO I and II.



Marshall Field and Co —

Riser No 4 – 6"

Grinnell Sprinkler Heads

① Heads Pendant – 1 to 7

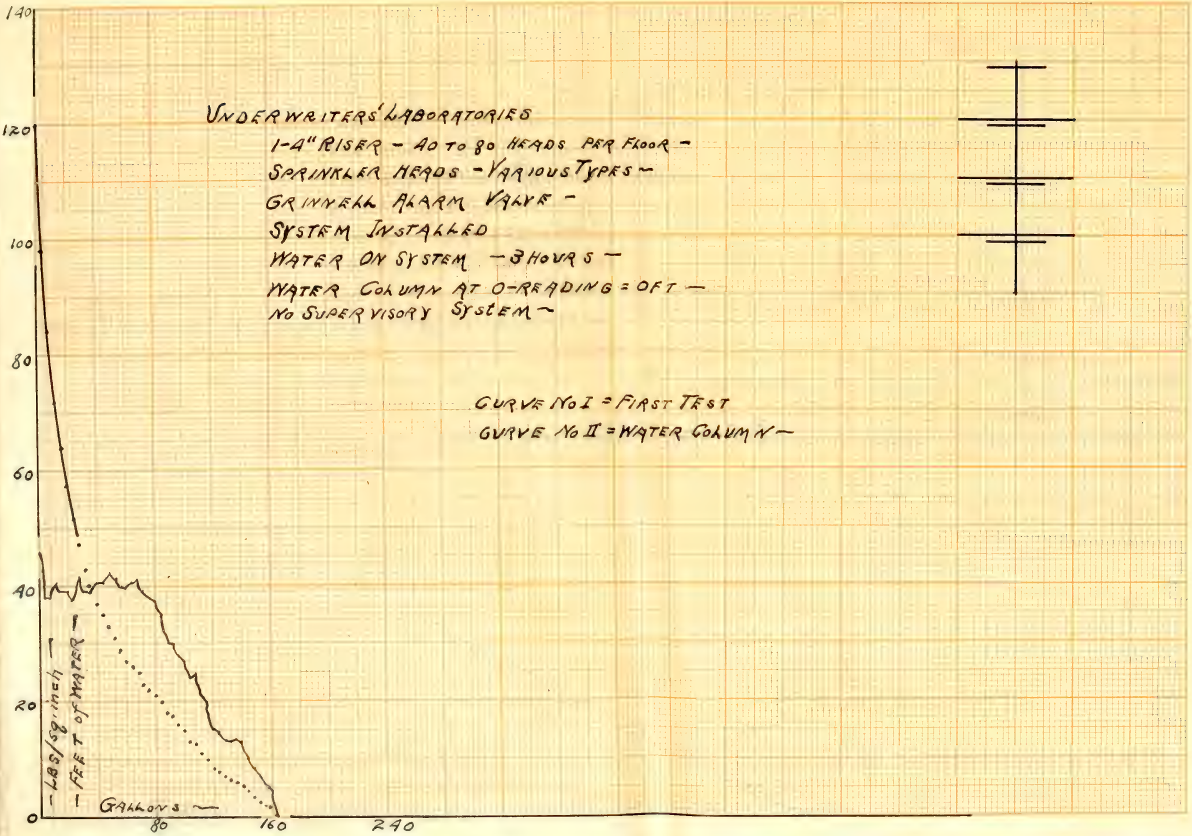
② Remaining Heads Upright —

Grinnell Alarm Valve —

System Installed – 1901-02

Water On System – About 2 Hrs –

Supervisory System –



UNDERWRITERS' LABORATORIES

1-4" RISER - 40 TO 80 HEADS PER FLOOR -

SPRINKLER HEADS - VARIOUS TYPES ~

GRINNELL ALARM VALVE -

SYSTEM INSTALLED

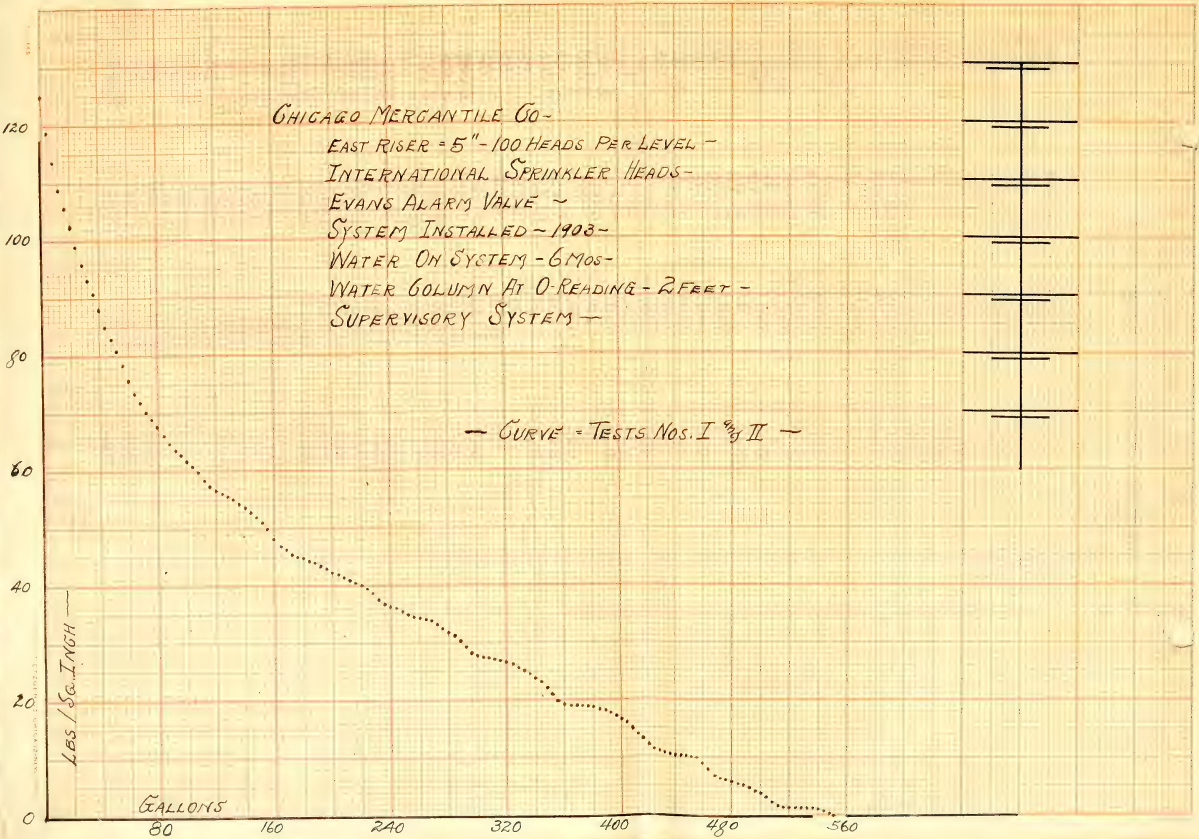
WATER ON SYSTEM - 3 HOURS -

WATER COLUMN AT 0-READING = 0 FT -

NO SUPERVISORY SYSTEM ~

CURVE NO I = FIRST TEST

CURVE NO II = WATER COLUMN -



CHICAGO MERCANTILE CO-

EAST RISER = 5" - 100 HEADS PER LEVEL -
INTERNATIONAL SPRINKLER HEADS -
EVANS ALARM VALVE ~
SYSTEM INSTALLED ~ 1903 -
WATER ON SYSTEM - 6 MOS -
WATER COLUMN AT 0-READING - 2 FEET -
SUPERVISORY SYSTEM —

— CURVE = TESTS NOS. I and II —

A. C. McCLURG & CO. WEST RISER.

FIRST TEST. BOTTOM READINGS.

120
112
108
101
97
92
88
85
81
78
75
73
70.5
68
66
64.5
62.5
61
59
58
56.5
55
54
53
52.5
50.5
49.5
48
47
46
45
44.5
43.5
42.5
42
41.5
41
40.5
40
39
38.5
38
37.5
37
36
35.5
35
35
35
34.5
34
33.5
33
32.5
32
31.5
31.5
31
30.1
29.9
29.5
29.3
29
28.7
28.5
28.2
27.9
27.5
27.2
27
26.8
26.5
26.3
25.8
25.5
25
24.7
24.2
23.8
23.4
23
22.7
22.2
21.8
21.5
21
20.8
20.3
20
19.8
19.7
19.6
19.5
19.2
19.1
18.9
18.7
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18.4
18.3
18.2
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17.9
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17.3
17.3
17.1
16.9
16.8
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16
15.7
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13.4
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12
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10.9
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10.3
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10
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2.4
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2.3
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2.1
2.1
2.1
2.1
2
2
2
1.9
1.7
1.4
1.1
.9
0.0
0.0
0.0
Suction.

A. C. McCLURG & CO. WEST RISER.

FIRST TEST. TOP READINGS.

95
90
84
79
74.5
70
66
63
59.5
57
54
51
49
46
45
42
40.5
38.5
37
35
34
32.5
31.5
30
29
28.5
27.5
25.5
25
25
23.5
23
22
21
20
19
18.6
17.4
16.8
16.8
16.2
15.8
15.5
15.2
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12.4
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11.5

11.1
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2.0
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2.8

2.9
3.0
3.1
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3.1
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3.4
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3.6
3.6
3.8
3.8
3.8
3.8
3.9
3.9
4.0
4.0
4.1
4.1
4.1
4.2
4.2
4.2
4.2
4.3
4.4
4.4
4.5
4.5
4.5
4.5
4.5

4.6
4.6
4.6
4.6

* All readings from star on are vacuum readings in pounds per square inch.

TRUAX, GREEN & CO.

SECOND TEST.

BOTTOM READINGS.

125.5	48.5	27.3	6
120.5	48	26.7	5.5
117	48	26	5.1
113	47.5	25.4	4.7
109	47	25.3	4
106	46.5	25	3.7
103	46	24.7	3.2
100	45	24.3	2.6
98	45	24	2.4
95	44.5	23.5	2.3
92	44.5	23	2.2
90	43	22.5	2.1
87	42.5	22	2
85	42	21.4	1.9
83	42	21	1.5
81.5	41.7	20.8	
80	41.3	20.7	
78	40.8	20.5	
77	40	20.3	
75	40	20.2	
73.5	39.8	20	
72.5	39.5	19.7	
71	39	19.0	
70	38	18.5	
69.5	38	18	
68	37.5	17.5	
67	37	16.8	
66	37	16.2	
65	36.5	15.8	
63.5	36	15.3	
62.5	36	14.8	
61	35.5	14.2	
60.5	35	13.5	
60	35	13	
59	34	12.5	
58	34	12.2	
57	33.5	12	
57	32	12	
56	32	11.8	
55	32	11.7	
55	32	11.5	
54	31.5	11.2	
53	30.5	10.5	
52	30.5	10	
52	29	9.3	
51.5	29	8.8	
51	29	8.1	
51	28.7	7.7	
50	28.5	7.5	
50	28.2	7	
50	27.8	6.5	
		6	

TOP READINGS.

88.5	--	--	--
84.5	--	--	--
80.5	9	--	--
76	--	--	--
72	--	--	--
69.5	--	--	0
66	--	--	--
63	--	--	--
60.5	--	--	--
58	7.5	--	--
55.5	--	2	--
53	--	--	0
51	--	--	
49	--	--	
46.5	--	--	
45	--	--	
43	--	--	
41	--	--	
39.5	--	--	
38	7	1	
--	--	--	
--	--	--	
34.5	--	--	
--	--	--	
--	--	--	
31	--	--	
--	--	--	
--	--	--	
28	5.5	--	
--	--	--	
--	--	--	
24.5	--	--	
--	--	--	
--	--	0	
22	--	--	
--	--	--	
--	--	--	
19.5	--	--	
--	--	--	
--	5	--	
17	--	--	
--	--	0	
--	--	--	
15	--	--	
--	--	--	
--	--	--	
13	--	--	
--	--	--	
12	--	--	
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--	3	0	
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TRUAX, GREEN & CO.

FIRST TEST.

BOTTOM READINGS.

127.5
114.5
104.5
97
90
85
79
75
72
68
65
63
60
57
55
53.5
52
51
49
48
46.5
45
44.5
43
42.5
41.5
41
40.5
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39
38.5
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37.5
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34.5
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33.5
33.5
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32.5
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32

32
31.5
31.5
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31
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30.8
30.5
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29.7
29.1
28.8
28.2
27.9
27.4
27
26.7
26.2
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25.7
25.3
25
24.8
24.4
24.1
23.9
23.7
23.5
23.3
23.2
23.1
23
22.8
22.8
22.7
22.7
22.4
22.2
21.9
21.5
21.1
20.8
20.4
20.1
19.8
19.3
19

18.8
18.5
18.2
18
17.8
17.4
17.2
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16.8
16.5
16.4
16.3
16.3
16.1
16.1
16
15.7
15.2
14.8
14.2
13.8
13.5
13.5
13.1
13
12.9
12.5
12.1
11.9
11.5
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10.7
10.2
9.9
9.8
9.7
9.6
9.6
9.6
9.5
9.3
8.9
8.3
7.9
7.4
7
6.5
6
5.5

5.1
4.8
4.3
4
3.6
3.2
2.8
2.4
2
2
2
2
1.9
1.8
1.7
1.6
1.4
1.2

WATER COLUMN
15 FEEB.

TOP READINGS.

91	--	--	--
79.5	--	--	--
68.5	3.67	--	--
61	--	--	--
54.5	--	--	--
48	--	--	--
43	--	--	--
38.5	--	--	6.18
35	--	--	--
31.5	--	5.3	--
28.5	--	--	--
25.5	--	--	--
23	--	--	--
21	4.5	--	--
19	--	--	6.22
17	--	--	
--	--	--	
--	--	--	
12	--	--	
--	--	--	
--	--	--	
8.5	--	5.45	
--	4.46	--	
--	--	--	
5	--	--	
--	--	--	
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00	--	-6.53	
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--	5.2	--	
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--	5.3	6.03	
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*All readings from star on are vacuum readings in inches of mercury.

175
172
170
168
167
166
164
163
162
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152
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144.5
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140.5
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137.5
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62.5
62.5
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61.5
61
60.5
60.5
60
59.5
59

A. G. SPALDING & CO.

FIRST TEST. BOTTOM READING. SECOND TEST.

167.5
143
124
110
97
90
83
77
72
68
64
60.5
57.5
55
52.5
50.5
48.2
47.5
45
44.7
43
42
41
40
39
38
38
37
36.5
35.5
34.5
34.5
34
33.5
33
32.5
32.5
32.5
31.5
31
31
30.5
30.2
29.8
29.5
29
28.5
27.9

27.3
27
26.5
26.1
25.8
25.6
25.3
25
24.6
24.3
23.9
23.3
23
22.8
22.6
22.4
22.2
22
21.6
21.2
20.6
20.3
19.7
19.2
18.9
18.6
18.4
18.1
18
17.6
17.4
17
16.5
16
15.8
15.5
15.3
15.1
15
14.8
14.7
14.5
14.3
14
13.6
13.3
12.9
12.5

12
11.8
11.5
11.3
11.2
11
10.7
10.5
10.2
9.9
9.6
9.2
8.8
8.5
8.2
8
7.6
7.3
7.2
6.5
6
5.5
5.2
4.7
4.3
3.9
3.6
3.4
3.2
3
2.8
2.5
2
1.5
1.4
1.2
0.9
.3
0.0

4.25 feet head.

162.5
154
146
138
132
126.5
121
116
112
108
104
100.5
96.5
94
91.5
88.5
86
84
82
79.5
78
76
74.5
73
71
69.5
68.5
66.5
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27.5
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24.5
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23.5
23
22.5
22.5
22
22

21
20.4
19.9
19.5
19.2
18.9
18.5
18
17.3
16.8
16
15.4
14.8
14.5
14.1
13.8
13.3
11.8
11.6
11.2
10.6
9.8
9
8.2
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7.8
7.5
7.3
7.1
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6.7
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5.5
5
4.7
4.5
4.3
4.1
3.9
3.8
3.5
3.2
3
2.9
2.6
2.3
2
2
1.8

1.5
1.3
1
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0.0
Blowing.

A. C. McCLURG & CO. WEST RISER.

SECOND TEST. TOP READING.

99
94.5
91
87
84
80.5
78
74.5
71.5
69
66.5
64.5
62
60
58
56
54.5
52.5
51
49.5
48.5
46.5
45
44
42.5
41
40.5
39
38
37
36
35
34.5
33.5
32.5
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28.5
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24.5
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22.5
22
21.5

20.5
19.7
19.3
18.8
18.3
17.7
17.4
17
16.5
16.2
15.5
15
14.7
14.4
14
13.6
13.3
12.9
12.6
12.3
11.9
11.6
11.3
11
10.9
10.6
10.3
10
9.8
9.5
9.2
8.9
8.7
8.4
8.2
7.9
7.8
.75
7.3
7.2
7
6.9
6.8
6.8
6.7
6.6
6.6
6.5
6.4
6.3

6.4

6.4

6.5
6.4
6.2
6.1
5.9
5.7
5.4
5.2

4.9
4.8
4.7
4.5

4.3
4.1
4
3.9
3.9

3.8
3.7
3.6
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3.5
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3.4
3.3
3.1
2.9
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.2
.1

A. C. McCLURG & CO. WEST RISER.

SECOND TEST. BOTTOM READINGS.

121.5
117
113
110
107
103
100
98
95
92.5
90
87.5
85
82.5
80
79
77.5
76
75
72.5
71.5
70
68
67
65.5
65
64
62.5
61.5
60
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58.5
57.5
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54.5
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47.5
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44.5

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43.5
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42.5
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41.5
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40.5
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37
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36.5
36.5
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34.5
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33
32.5
32.5
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32
31
30.5
30.1
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29.8
29.5
29.2
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28.8
28.5
28
27.8
27.5
27.2
26.9
26.6
26.2
26

25.7
25.3
25
24.8
24.4
24
23.7
23.4
23.2
23.1
22.9
22.7
22.5
22.4
22.3
22.1
21.9
21.8
21.7
21.5
21.3
21.2
21
20.7
20.5
20.2
19.9
19.7
19.3
19
18.7
18.4
18.1
17.8
17.4
17.1
16.9
16.4
16
15.7
15.3
15.2
15.1
15
14.9
14.7
14.6
14.6
14.5
14.3

14.2
14.1
14
13.9
13.8
13.5
13.3
12.9
12.5
12.1
11.9
11.6
11.2
10.9
10.5
9.9
9.4
9
8.5
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7.9
7.7
7.4
7.2
7
6.5
6.2
5.8
5.4
5
4.5
4.3
3.9
3.4
3
2.8
2.3
2
1.7
1.5
1.3
1.2
.1
.0.

ALBERT PICK & CO.

NORTH RISER. EAST SECTION. SECOND TEST.

BOTTOM READINGS.

121
112
105
98.5
93
87.5
82
78.5
74.5
71
68
65.5
63.5
61
58.5
57
55
53
51
50
48.5
47
45.5
44
43
42
40.5
39
38.5
37
36
35.5
35
34
33
32
32
31
29.8
28.8
27.9
26.8
25.8
25.2
24.7
24.1
23.8
23.4
22.8
22
21.3
20.5
19.8
19
18
17.3
16.4
16
15.1
14.8
14.6
14.2
13.9
13.6
12.9
11.8
11.1
10.2
10
9.8
9.5
9.3
9.2
9
8.6
8.2
7.6
6.7
5.7
4.8
4.2
4
3.9
3.7
3.5
3.3
3.1
2.8
2

TOP READINGS.

92
85
78
72
67
62
57
53
49
46
43
40
37
35
33
31.5
30.1
28.5
26.9
25.3
24
23
22.1
21.2
20.5
19.8
19.1
18.7
18.1
17.8
17.4
16.8
16
15.3
14.7
14.1
13.7
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12.7
12.5
12.4
12.3
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11.5
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10.7
10.3
9.8
9.7
9.3
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8.8
8.7
8.5
8.4
8.2
8
7.9
7.6
7.4
7.2
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6.3
6.2
6.1
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5.9
5.7
5.4
5.1
4.9
4.7
4.5
4.3
4.1
3.9
3.9
3.8
3.8
3.4
3.1
3
2.9
2.7
2.5
2.2

WILSON BROS. NORTHWEST RISER.

BOTTOM READINGS.

FIRST TEST.

- 135.5
- 130
- 127
- 122
- 118
- 114.5
- 111
- 108
- 105.5
- 102.5
- 100
- 98
- 95
- 93
- 92
- 90
- 87.5
- 86.5
- 84
- 82.5
- 81
- 80
- 78.5
- 78
- 77
- 76
- 75
- 74
- 72.5
- 72
- 71
- 70.5
- 70
- 68
- 67.4
- 66
- 65
- 64
- 62.5
- 62
- 61
- 60
- 60
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- 59
- 58.5
- 57
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- 56
- 55
- 52.5
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- 49.5
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- 42.5
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- 41.5
- 41.5
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- 40.5
- 40.5
- 39.5
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- 37.5
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- 34.5
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- 33.5
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- 32.5
- 32
- 31.5
- 30.5
- 30
- 29
- 28.7
- 28.5
- 28.2
- 28
- 27.8
- 27.5
- 26.5
- 25.5
- 24.5
- 23.7
- 22.8
- 22.4
- 22.2
- 22
- 22
- 21.8
- 21.5
- 21.3
- 20.5
- 19.2
- 18
- 16.5
- 16.1
- 15.9
- 15.7
- 15.5
- 15.1
- 14.1
- 13
- 11.1
- 10
- 9.9
- 9.7
- 8.7
- 7.3
- 5.6
- 4
- 3.3
- 3.2
- 3
- 2.3

SECOND TEST.

- 135
- 130
- 126
- 122
- 117
- 112.5
- 110
- 107
- 105
- 102
- 98
- 96
- 93.5
- 92
- 90
- 88
- 86
- 85
- 83
- 82.5

Discontinued here.

WILSON BROS. SOUTHWEST RISER.

BOTTOM READINGS.

FIRST TEST.

NO SECOND TEST.

132.5
130
127
124
121.5
118
116
113.5
111.5
108.5
107.5
104.5
102
99.5
98
97
95.5
94
92
91
90
89
88.5
86.5
85
84.5
83.5
83
82
81
80
78.5
78
77
75
74
72.5
72
71.5
70.5
70
69.5
68.5
68
67.5
67.5
67

66
65
65
64
63.5
62
62
61
60
58.5
58.5
58
57
57
57
56.5
56
55.5
55
54
53.5
53
52
51.5
50.5
49.5
49
48.5
48
47.5
47
47
46.5
46
45.5
45
44
43
42.5
41.5
41
40.5
40.5
40
39.5
39.5
39

38
37.5
37
36.5
35
34
33.5
33.5
33
33
33
32.5
32.5
32.5
32.5
32
31.5
30.5
30
28
27
26.3
26.1
26
25.8
25.5
25.4
25.2
25
25
24.5
23.9
23
22.1
21.2
20.3
19.5
19.2
19.2
19
19
18.8
18.7
18.5
18
18
17.6
17

16.2
15.2
14.3
13.4
13
12.8
12.6
12
11.3
10.2
9.2
8
6.8
6.5
6.3
6
4.6
4.5

CHICAGO MERCANTILE CO.

EAST RISER. BOTTOM READINGS.

FIRST TEST.

125
119.5
114.5
109
105
101.5
97.5
93
91
88
85
82.5
80.5
78
76
75
73
70.5
70
68
66.5
65
64
63
61.5
61
60
58.5
58
57
56.8
56.4
55
54.8
52
52.5
52
51.2
50
48.5
47.8
47
46
45.2
45
45
44.2
43.8

43
42.7
42.4
42
41.7
41.5
40.8
39.5
38.5
38
37
37
36.7
36
35.5
35
35
35
34.6
33.8
33
32.4
31.8
30.4
29.8
28.5
28
27.7
27.4
27.1
27
26.6
26.4
26
25.6
25
24.2
23.5
22.7
21.8
20.9
20
19.6
19.6
19.4
19.1
19
19

18.8
18.4
17.8
17
16.3
15.5
14.8
13.9
13
12
11.5
11.3
11.2
11
10.9
10.7
10.5
9.4
8.8
8.
7.3
6.6
6.3
6.2
5.8
5.3
4.8
4.2
3.7
3
2.6
2 2
1.7
1.4
1.4
1.3
1.2
1.1
1
.8
.5
.0

SUCTION
WATER COLUMN
2 FEET.

SECOND TEST.

125
121
115.5
110
106
102
98.5
95.5
89
86
83.5
83.5
79.5
77
76
73
71.8
70
69
67.5
66.3
65
64
63
61.8
60.3
59.6
58.5
58
57
56
55
54.5
52.5
52
50.5
49.8
48.5
48
47
47
46.8
46
46
45
45
44.2
43.8
43

42.5
42
41
40
39
38
37.7
37.5
37.3
37.3
37
36.8
35.8
35.2
35
35
34.5
33
32.2
32
32
31
30
29.1
28.7
28.3
28.1
28
27.7
27.5
27.1
27
26.7
26
25.3
24.8
24
23.2
22.2
21.7
20.9
20.2
19.8
19.7
19.4
19.2
19.1
19
18.8

18.4
17.9
17.2
16.5
15.7
14.9
14.3
13.5
12.7
11.8
11.5
11.4
11.2
11
10.8
10.6
10.4
10
9.4
8.6
8.2
7.7
7.1
6.5
6.1
5.9
5.7
5.5
4.8
4.3
3.8
3.3
2.8
2.4
1.7
1.2
1
1
.8
.2
.0

SLIGHT BLOWING.

ALBERT PICK & CO.

NORTH RISER. EAST SECTION. FIRST TEST.

BOTTOM READINGS.

121	18.3
108	17.6
97	16.7
87.5	16
80.5	15.2
74	14.3
69	14.2
65	14
61	13.9
57	13.7
54	13
52	12.3
49	11.5
47	10.8
45	10
43	9.4
41.5	8.8
40	8
38	7.8
37.5	7.8
35.5	7.5
35	7.3
33.5	7.2
32.5	7.1
32	7
31.7	6.8
30.5	6
30	5.2
29.3	4.3
28.7	4
28	3.8
27.3	3.8
26.9	3.5
26.2	3.3
25.7	3.2
25.1	3.1
24.5	3
24	2.5
23.3	1.7
22.8	Water column
21.9	7 feet.
21.2	
20.9	
20.4	
20.1	
20	
19.6	
19.1	

TOP READINGS.

93	0.0
81	0.0
70	0.0
62	0.0
55	0.0
49	0.0
44	0.0
39.5	0.0
35.5	0.0
32	0.0
29.5	0.0
27.2	0.0
24.5	0.0
23.5	0.0
20.6	0.0
18.7	0.0
17	0.0
15.5	0.0
14.1	0.0
12.8	0.0 *
11.6	.8
10.5	1.2
9.5	1.6
8.4	1.8
7.4	2
6.5	2.1
5.7	2
4.9	1.8
4.2	1.9
3.4	2.2
2.8	2.4
2.4	2.6
2	2.8
1.8	3
1.7	3.3
1.6	3.5
1.5	3.7
1.4	3.7
1.4	
1.3	
1.6	
1.7	
1.4	
1.2	
.8	
0.0	
0.0	
0.0	
0.0	

* All readings from star on are vacuum readings in inches of mercury.

THOMPSON & TAYLOR.

EAST RISER. FIRST TEST.

BOTTOM READINGS.

122.5
111
101
92
86
81
76
72
68
65
63
60
57.5
55
52
50.5
47.5
46
43
42
40
38
36.5
35
33
32
30
28.6
27.4
26.1
24.8
23.6
22.5
21.4
20.3
19.3
18.3
17.3
16.3
15.4
14.8
14
13.2
12.4
11.6
10.9
10.3
9.8
9
8.8
8.3
7.7
7
6.4
5.8
5.1
4.3
4
1.9
1
.3
.1
0.0

Water column 2.5 feet.

TOP READINGS.

79
67
57.5
49.5
45
39
35
32
29
26.5
25.5
24
22
19.5
18
16.4
15.2
14
13
12
11.1
10.2
9.4
8.8
8.1
7.4
6.9
6.3
5.9
5.8
5.1
4.9
4.5
4.1
3.9
3.3
3.1
2.8
2.6
2.4
2.1
1.9
1.8
1.6
1.4
1.3
1.2
1.2
1.1
1
.7
.3
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0

THOMPSON & TAYLOR.

EAST RISER. SECOND TEST.

BOTTOM READINGS.		TOP READINGS.	
121	9.1	82	1.7
111	8.5	71	1.7
102	7.9	61	1.7
95	7	52	1.6
88	6	49	1.4
82	5	43	1.2
78	3.5	39.5	1.1
74	2.3	35	.8
70	1.9	32	.3
67.5	1.3	29	.1
65	0.0	27	
61.5		25	
58		23.2	
55		21	
53		19.8	
50.5		18.4	
48.5		17.1	
46		15.9	
44		14.9	
42.5		13.9	
40.5		13	
38		12	
37		11.2	
35		10.5	
33		9.9	
32		9.1	
30		8.6	
29		8	
27.5		7.6	
26.5		7.1	
25.3		6.7	
24		6.3	
23.1		5.8	
22		5.4	
21		5.2	
20		4.9	
18.9		4.5	
18		4.2	
17		4	
16.2		3.7	
15.6		3.4	
14.9		3.2	
14.2		3	
13.3		2.9	
12.7		2.7	
12.1		2.6	
11.4		---	
10.7		2.3	
10		2.2	
9.6		2.1	
		1.9	

Water Column
3.5 feet.

MORRIS, MANN & REILLY.

BOTTOM READINGS.

FIRST TEST.

120
98
82
72.5
65
58
54
51
47.5
45
42.5
41
39.5
38.5
37.5
37
36
35.5
35
34
3355
33
32.5
32
31.7
31.5
31
30.3
29.7
29
28.3
27.9
27.5
26.9
26.3
26
25.5
25.1
24.8
24.4
24.2
24.1
24
23.9
23.8
23.7
23.5
23.3

23.2
23.1
22.9
22.4
21.7
21.3
20.9
20.4
20.2
19#7
19.3
19
18.6
18.3
18
17.6
17;4
17.3
17.3
17.2
17.2
17.1
17
16.9
16.7
16.3
15.8
15.3
15
14.5
14.2
13.7
13.3
12.9
12.5
12.2
11.5
11.2
11.1
11
11
10.9
10.6
9.9
9.3
8.7
8.1
7.5

6.8
6.4
6
5.6
5.3
4.9
4.9
4.8
4.7
4.7
4.7
4.7
4.6
4.6
4.6
4.5
4.5
4.5
4.4
4.3
4
3.3
2.9
2.4
1.8
1.4
1
.1
0.0

$ECOND TE$T

121.5
116
112
107.5
103
99
95
92
89
86.5
84.5
82
78.5
77
75
73
71.5
70
68
66.5
65
63.5
62
61.5
60.5
59.5
58.5
57
56.5
56
55.5
54.5
54
52.5
51.5
51
50
49.5
49
48
47.5
46.5
46
45.5
45
44.5
44
43.5
42.5

42
41.5
41
40.5
40.5
40
39.5
39
38.5
38.5
38
37.5
37
36
35.5
35
35
34
33.5
33
32
32
31.5
31

30.8
30.5
30.2
29.7
29.2
28.7
28
27.5
26.9
26.3
25.6
25.1
24.8
24.5
24.3
24.1
23.9
23.7
23.3
22.8
22.2
21.4
20.7

20.1
19.3
18.6
17.8
17.4
17.3
17.1
16.9
16.7
16.4
15.9
15.2
14.4
13.6
12.7
11.7
10.9
10.4
10.3
10.2
10.1
9.9
9.3
8.4
7.5
6.5
5.3
3.9
2.7
2.5
2.4
2.3
2.2
1.8
1
0.0

A. C. McCLURG & CO. EAST RISER.

FIRST TEST. BOTTOM READINGS.

121
113
105.5
100
94.5
89
83.5
80.5
77
74
70.5
68
65
63
61.5
59.5
57.5
55
54.5
53
51
50
48.5
47.5
46
45
44
43
42.5
41.5
40.5
40
39
38.5
37.5
37
36.5
36
35.5
35
34.5
34
33
32.5
32
29.6
29.2
28.8
28.3
28

27.6
27.2
26.9
26.7
26.1
25.9
25.5
25.2
24.9
24.5
24.3
23.8
23.7
23.5
23.2
23
22.8
22.5
22.2
22
21.8
21.6
21.3
21.1
21
20.8
20.6
20.4
20.2
20.1
20
19.8
19.6
19.4
19.3
19.2
19.1
19
18.8
18.7
18.7
18.5
18.3
18.2
18
18
17.9
17.7
17.6
17.5

17.3
17.2
17
16.7
16.3
16
15.7
15.5
15.1
15
14.8
14.1
13.9
13.5
13.2
13
12.8
12.6
12.7
12.5
12.3
12.3
12.2
12.1
12.1
12
12
11.9
11.9
11.8
11.8
11.6
11.5
11.4
11.2
10.8
10.5
10.2
10
9.8
9.5
9.2
9
8.8
8.5
8
7.9
7.8
7.4
7.2
6.9

6.7
6.5
6.3
6.3
6.3
6.2
6.2
6.1
6.1
6.1
6
6
6
5.9
5.8

TEST NOT COMPLETED.

AT
127

Thesis: EFFECT OF ENTRAPPED AIR ON THE ACTION OF WET PIPE ALARM VALVES

1909

Ahern-McKarahan-Oberfelder-Tregay

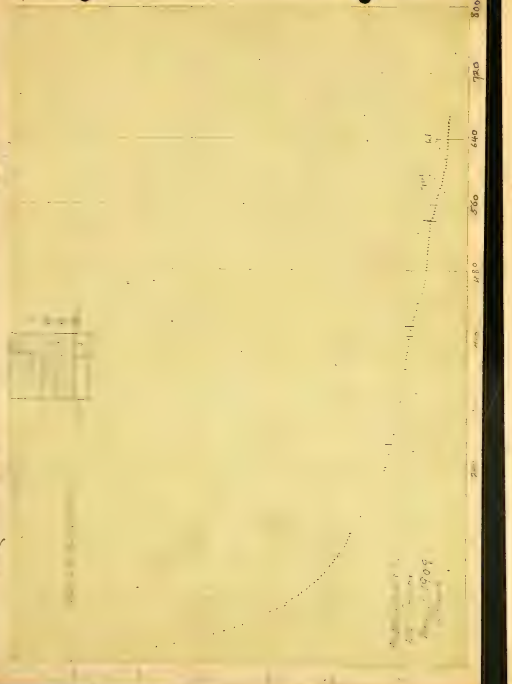
enclosed: DATA ORIGINALS

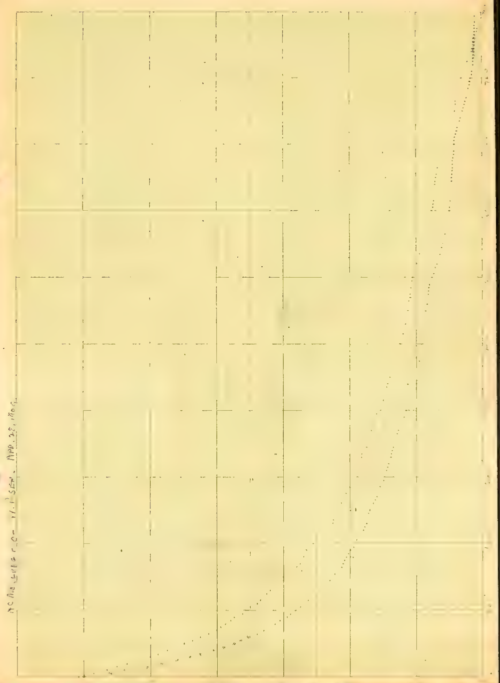
EXTRA SHEETS

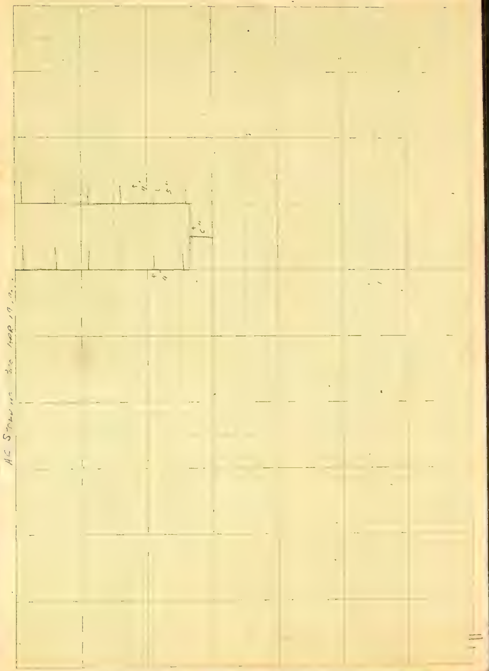
ILLINOIS INSTITUTE
OF TECHNOLOGY
Transforming Lives Inventing the Future

Illinois Institute of Technology
Chicago, Illinois 60616-3793

12, 2, 4)
19, 6, 114


800
720
640
560
480
1909


MC No. ... Sen. Apr. 25, 1909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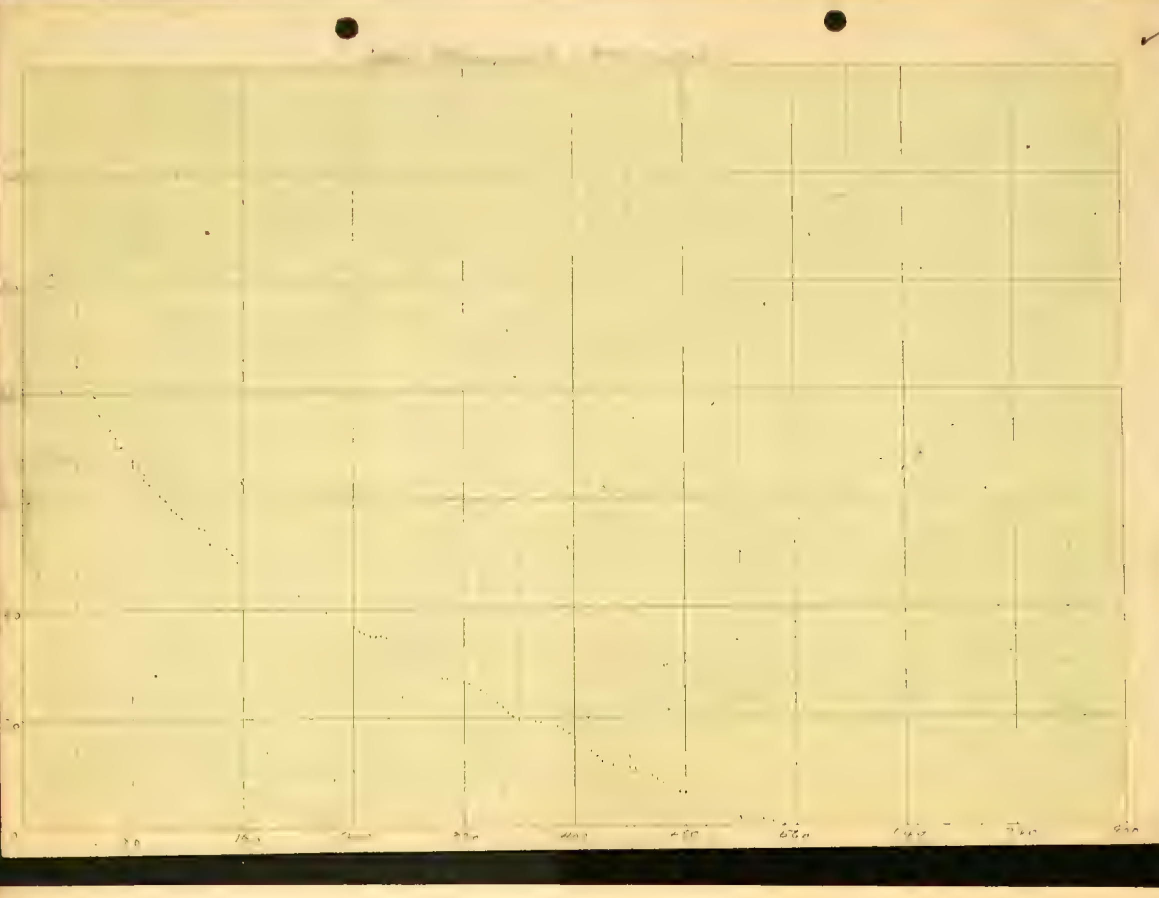
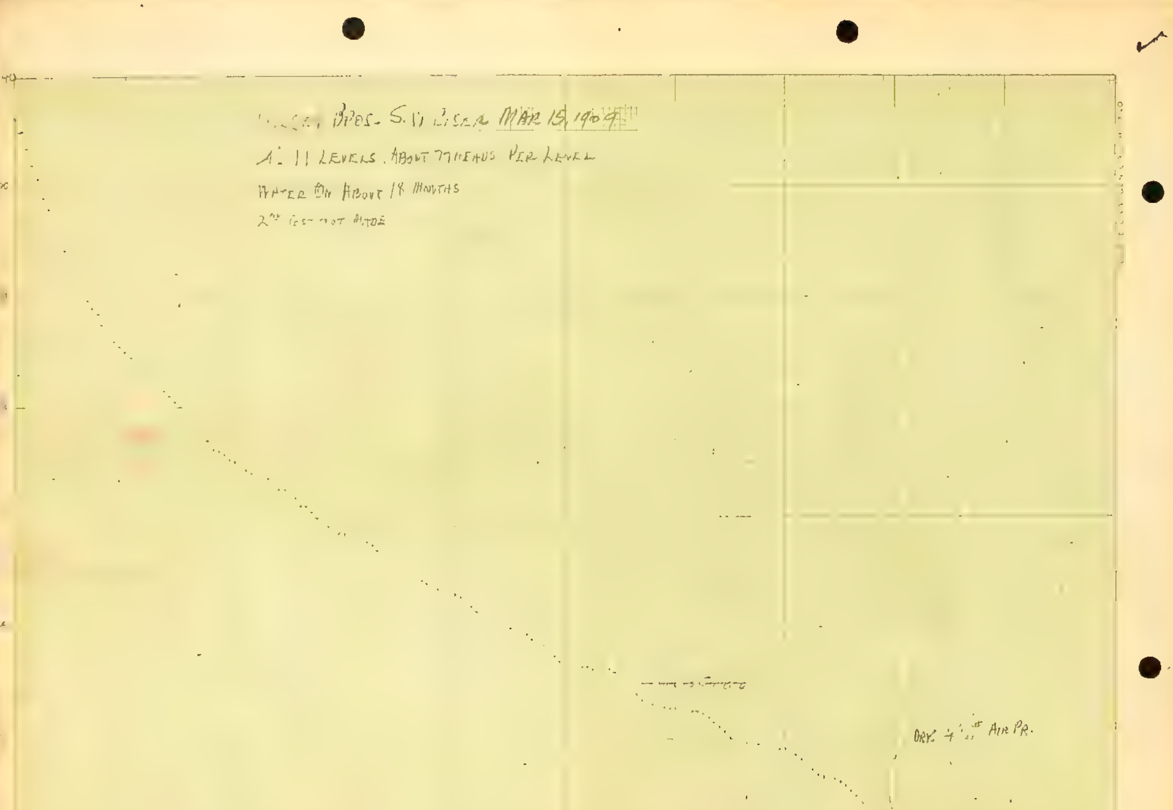




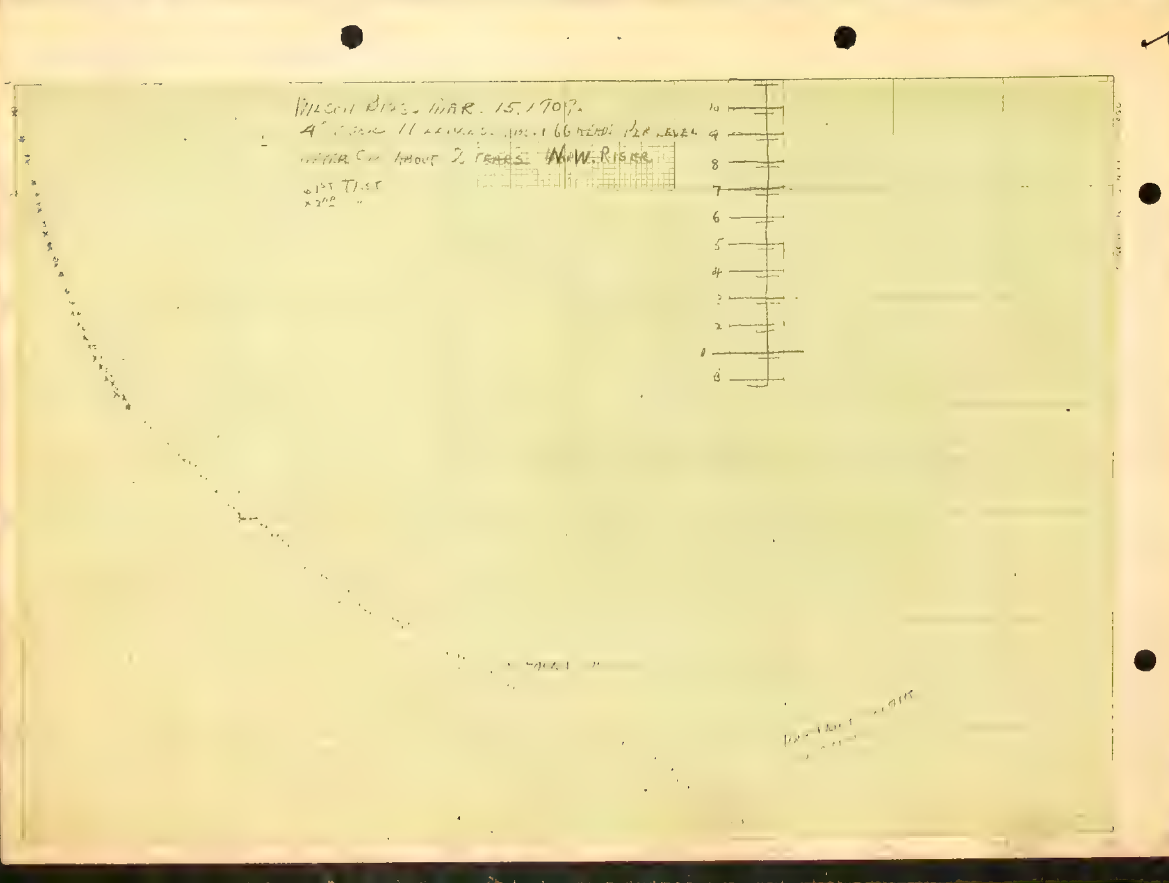
WILSON BROS. S.W. RISER MAR 15, 1909

A: 11 LEVELS. ABOUT 77 READS PER LEVEL

WATER ON ABOUT 18 MONTHS

2ND TEST NOT MADE

DRY. 4 [illegible] AIR PR.



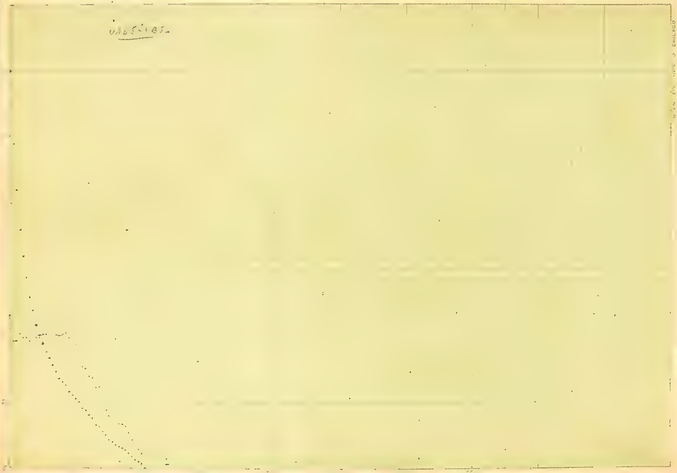
WILSON BROS. MAR. 15, 1909.

4" [illegible] 11 LEVELS. ABOUT 66 READS PER LEVEL

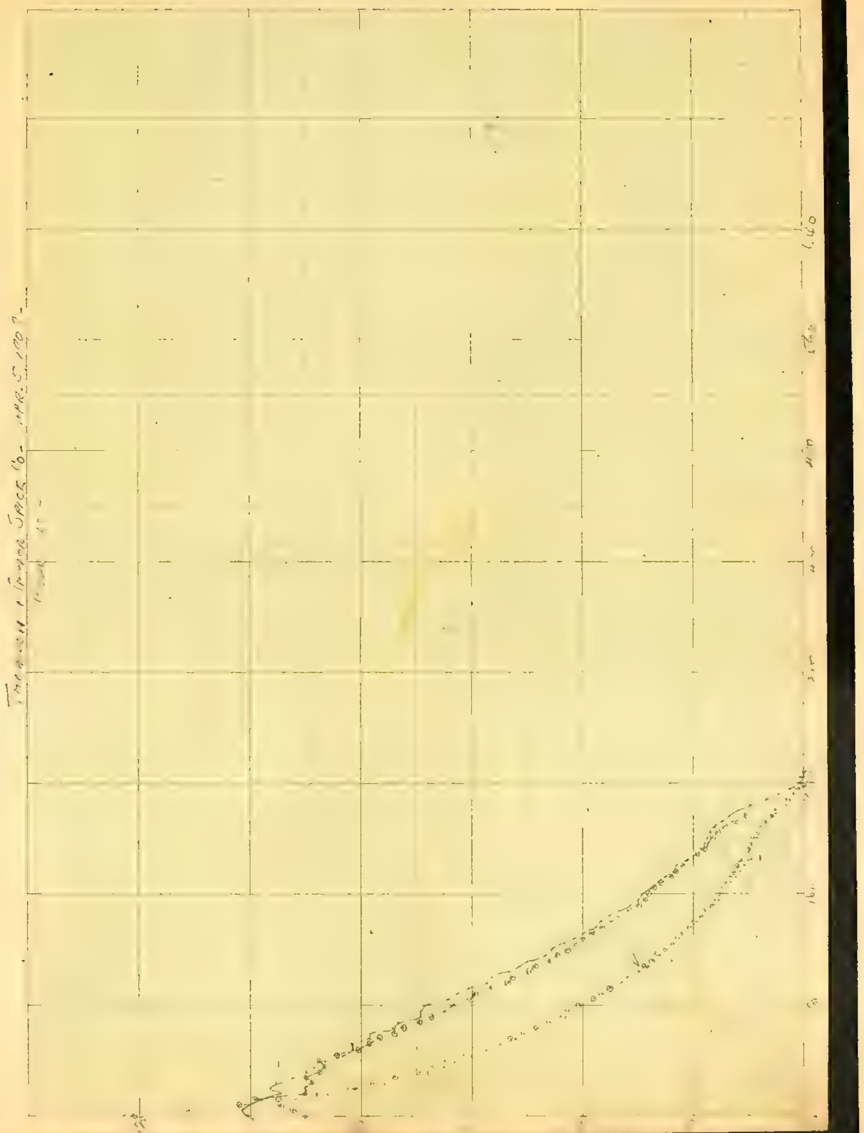
WATER ON ABOUT 2 YEARS. N.W. RISER

• 1ST TEST

× 2ND "



6th
5th
4th
3rd
2nd
1st
B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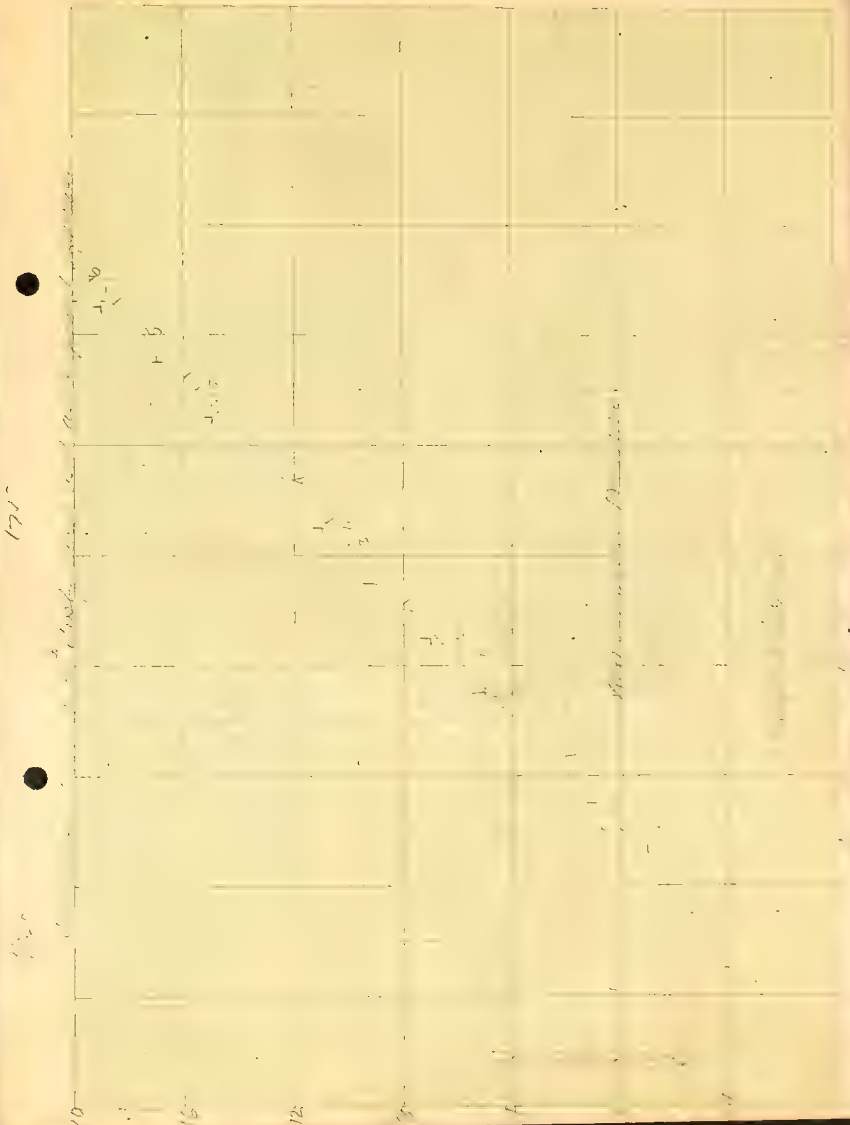
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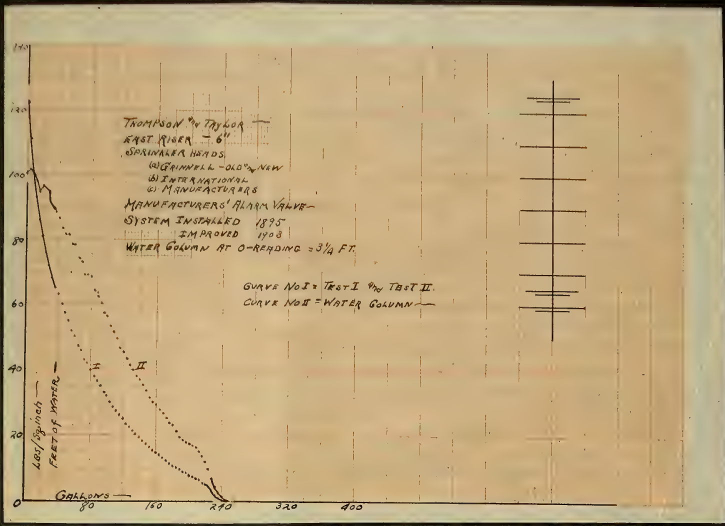
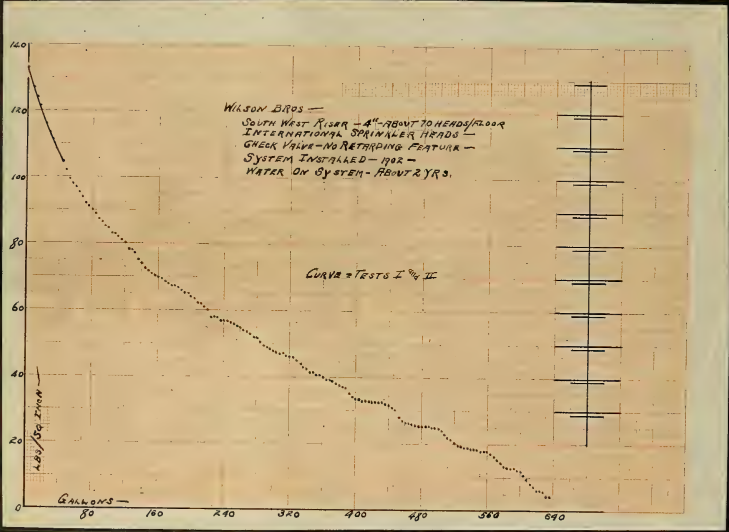
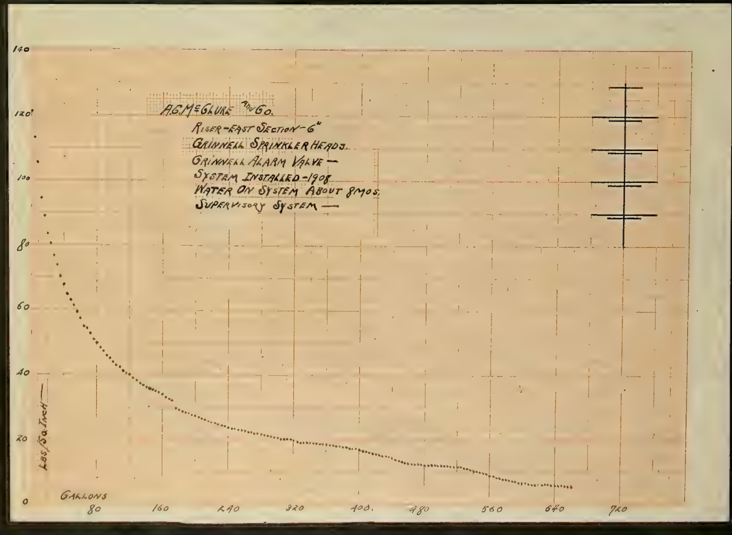
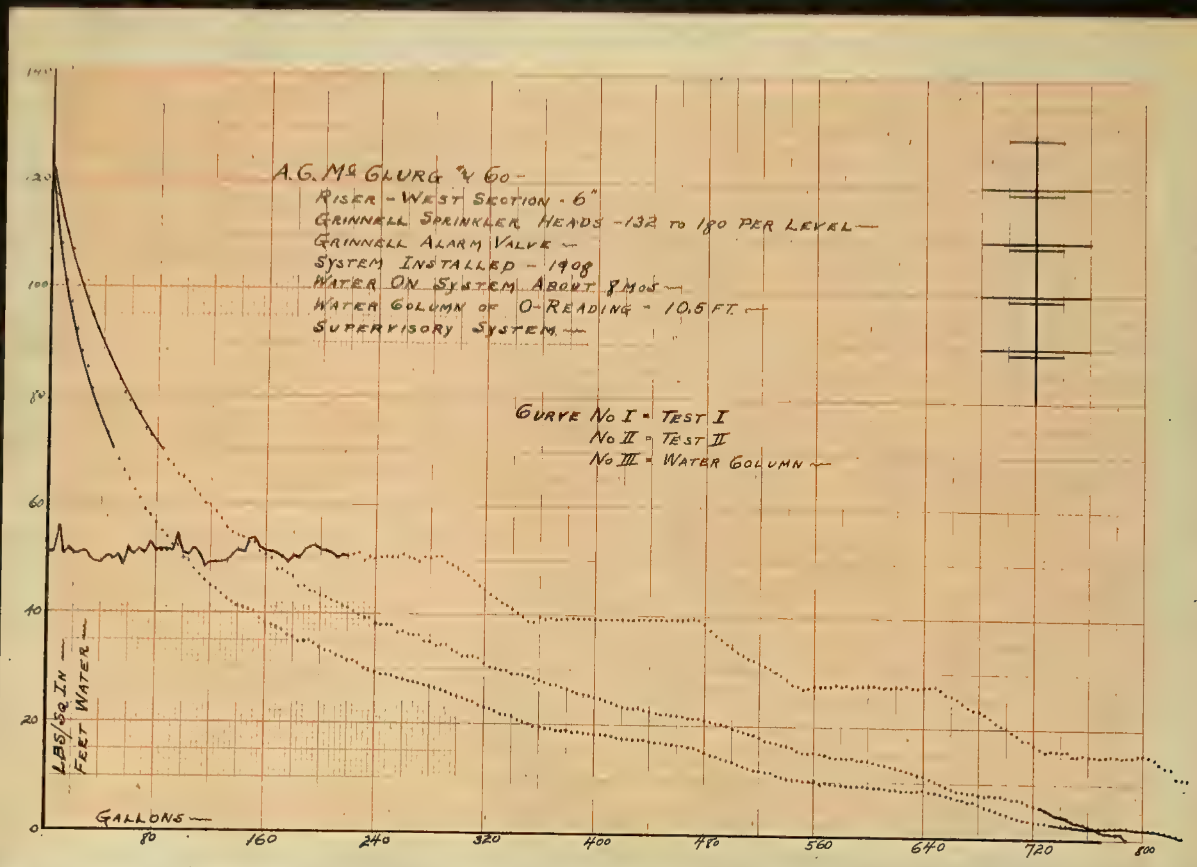
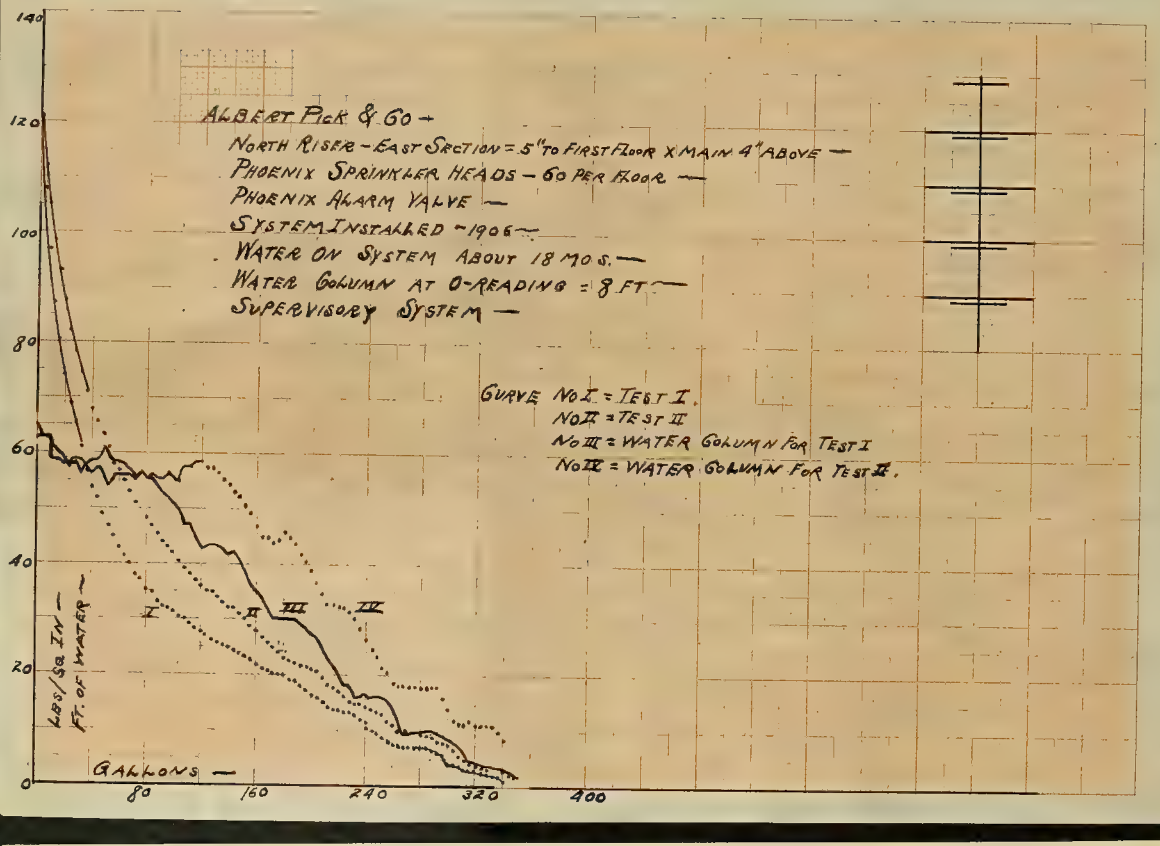
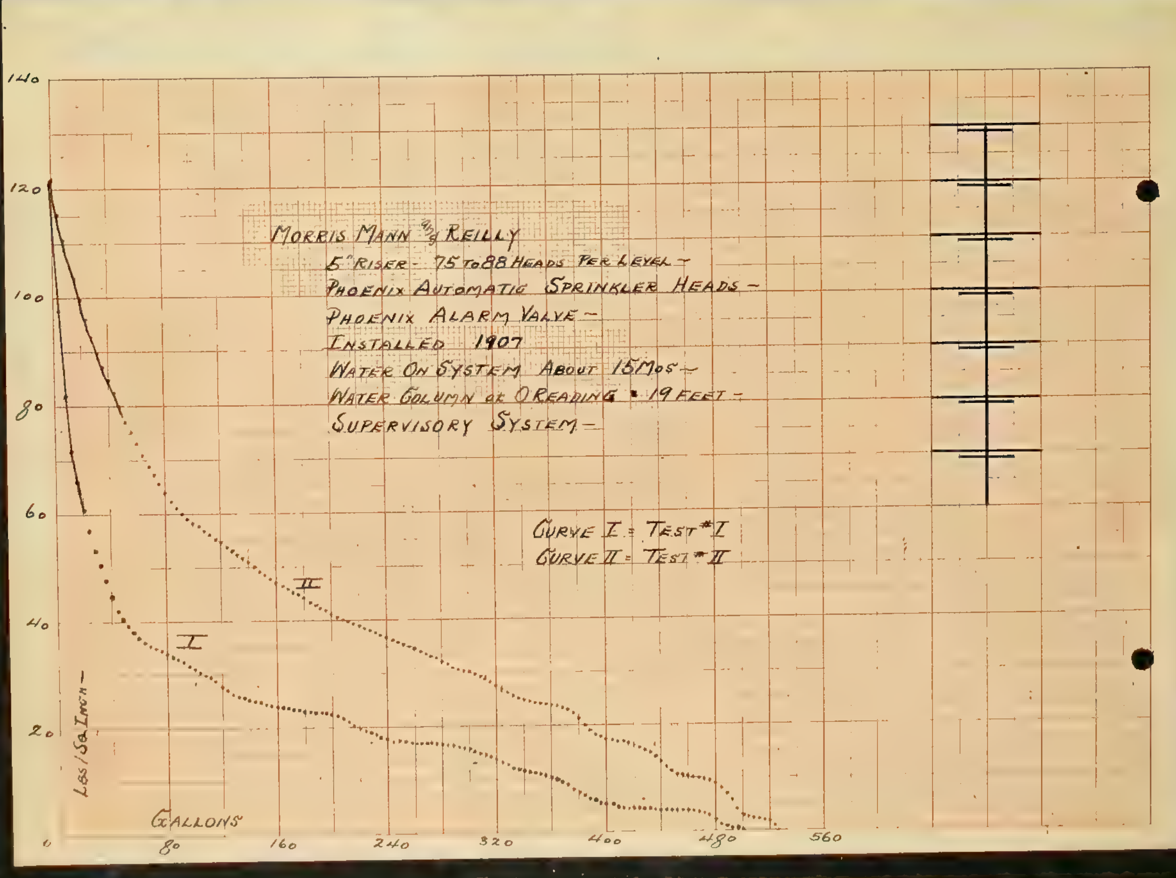

THOMPSON AND TAYLOR —
EAST RISER — 6"
SPRINKLER HEADS
(a) GRINNELL — OLD AND NEW
(b) INTERNATIONAL
(c) MANUFACTURERS
MANUFACTURERS' ALARM VALVE —
SYSTEM INSTALLED 1895
IMPROVED 1903
WATER COLUMN AT 0-READING = 3¼ FT.
CURVE NO I = TEST I AND TEST II.
CURVE NO II = WATER COLUMN —
I
II
LBS/Sq.inch —
FEET of WATER —
GALLONS —
140
120
100
80
60
40
20
0
80
160
240
320
400

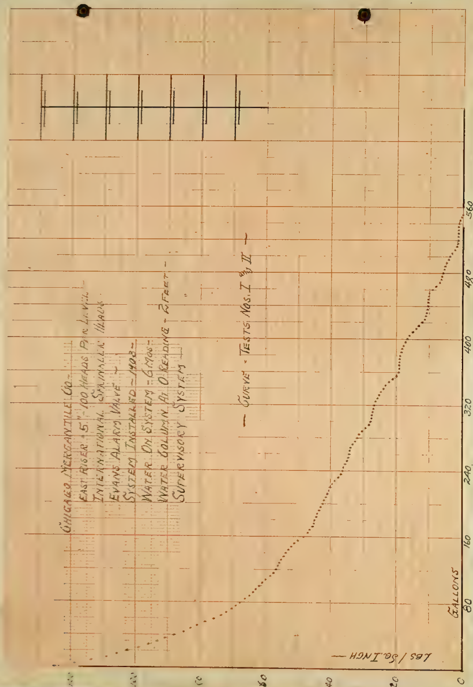

WILSON BROS —
SOUTH WEST RISER — 4" — ABOUT 70 HEADS/FLOOR
INTERNATIONAL SPRINKLER HEADS —
CHECK VALVE — NO RETARDING FEATURE —
SYSTEM INSTALLED — 1902 —
WATER ON SYSTEM — ABOUT 2 YRS.
CURVE = TESTS I AND II
LBS/SQ INCH —
GALLONS —
140
120
100
80
60
40
20
0
80
160
240
320
400
480
560
640

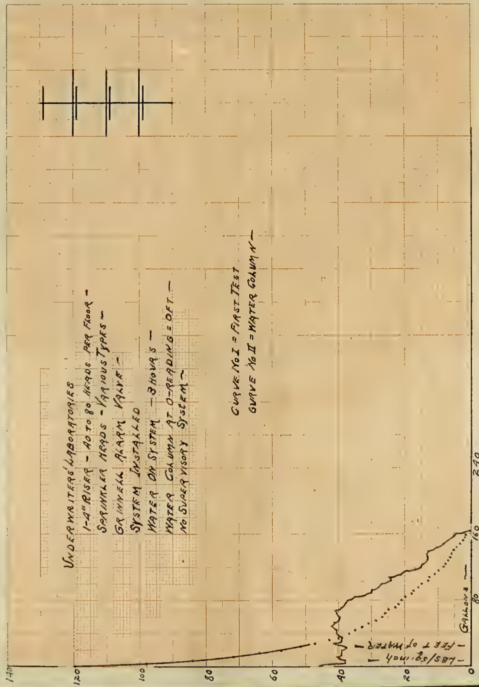

A.G. McCLURE AND CO.
RISER — EAST SECTION — 6"
GRINNELL SPRINKLER HEADS.
GRINNELL ALARM VALVE —
SYSTEM INSTALLED — 1908
WATER ON SYSTEM ABOUT 8 MOS.
SUPERVISORY SYSTEM —
LBS/SQ INCH —
GALLONS
140
120
100
80
60
40
20
0
80
160
240
320
400
480
560
640
720

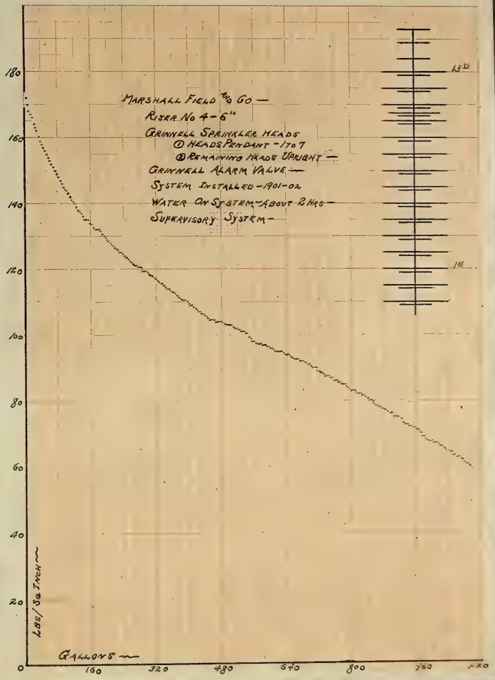

A.G. McClurg & Co –
Riser – West Section – 6"
Grinnell Sprinkler Heads – 132 to 180 per Level –
Grinnell Alarm Valve –
System Installed – 1908
Water on System About 8 Mos –
Water Column of O-Reading – 10.5 FT. –
Supervisory System –
Curve No I = Test I
No II = Test II
No III = Water Column –
LBS/SQ IN –
FEET WATER –
GALLONS –
0
20
40
60
80
100
120
140
80
160
240
320
400
480
560
640
720
800

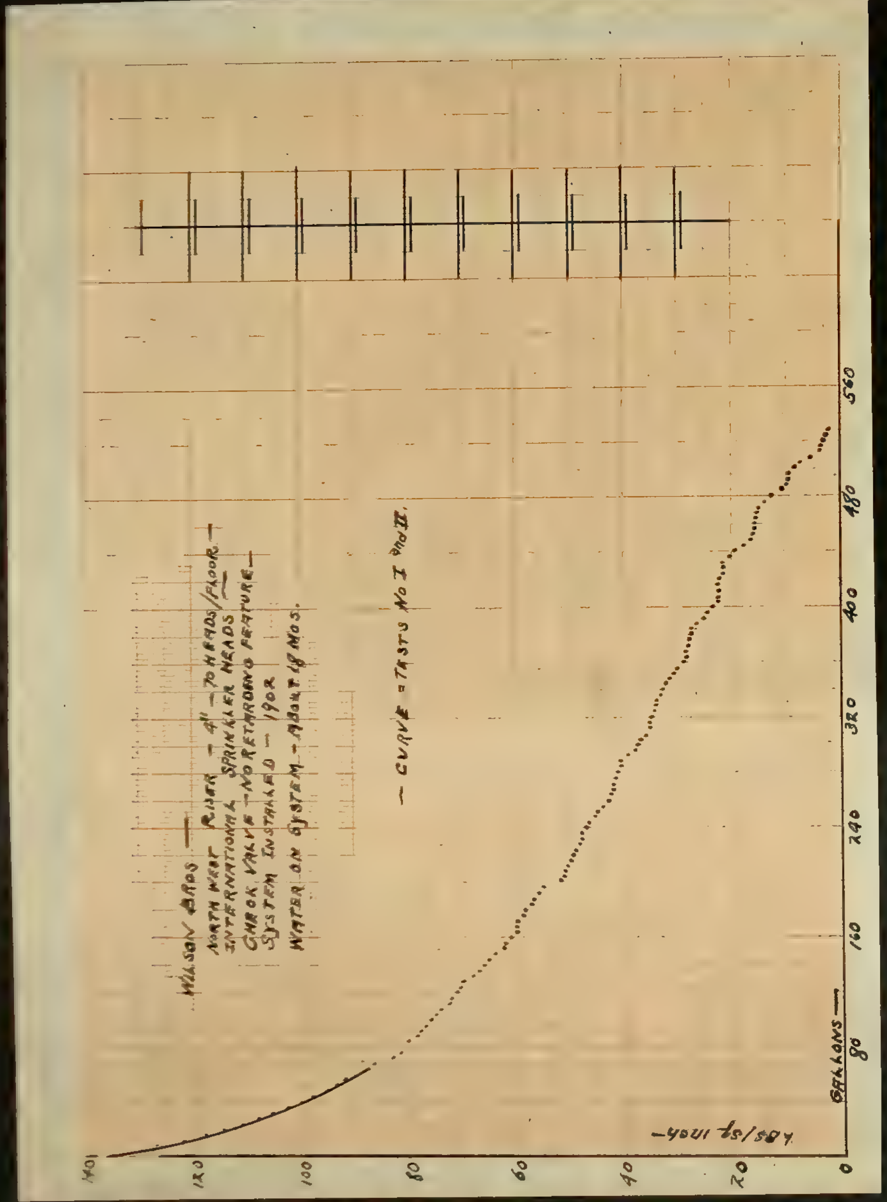

Albert Pick & Co –
North Riser – East Section = 5" to First Floor X Main 4" Above –
Phoenix Sprinkler Heads – 60 per Floor –
Phoenix Alarm Valve –
System Installed – 1906 –
Water on System About 18 Mos. –
Water Column at O-Reading = 8 FT. –
Supervisory System –
Curve No I = Test I.
No II = Test II
No III = Water Column for Test I
No IV = Water Column for Test II.
I
II
III
IV
LBS/SQ IN –
FT. of WATER –
GALLONS –
0
20
40
60
80
100
120
140
80
160
240
320
400

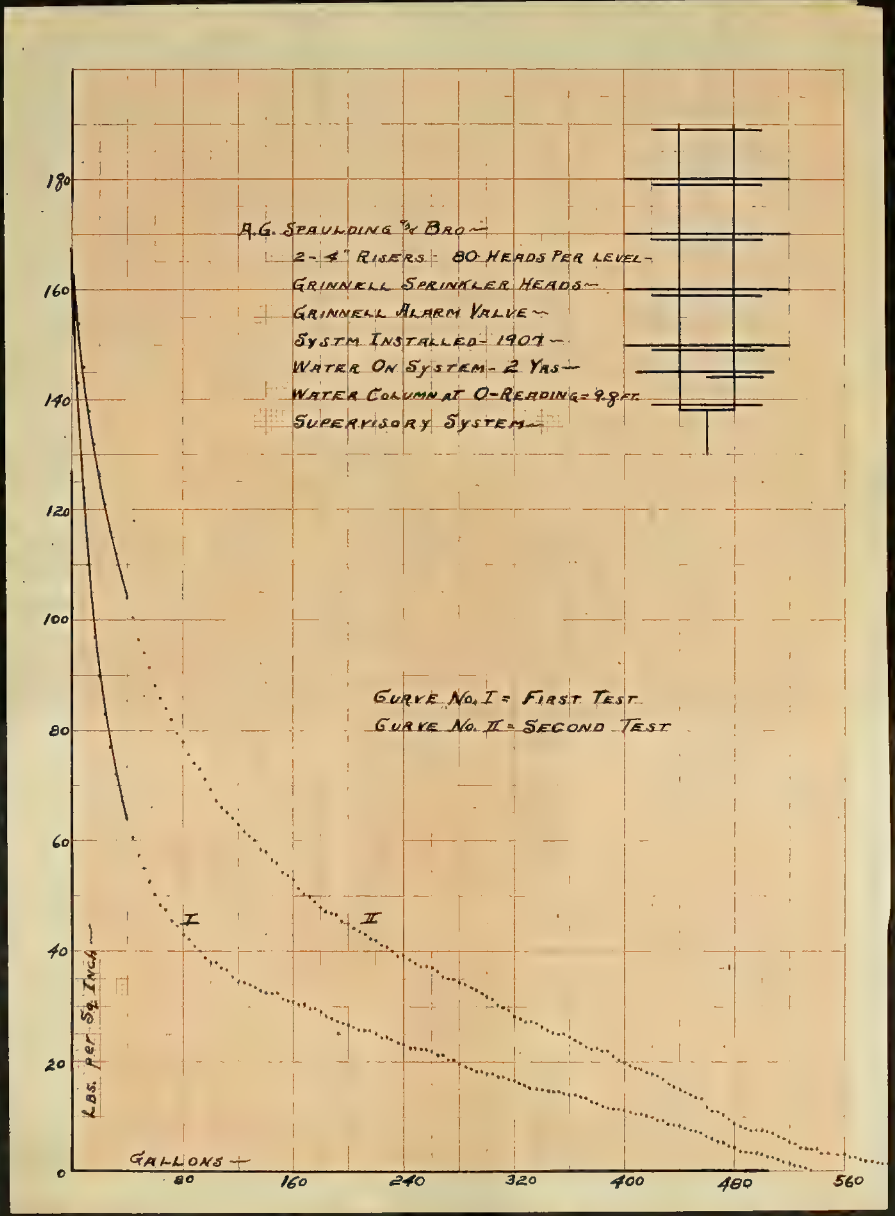

Morris Mann & Reilly
5" Riser – 75 to 88 Heads per Level –
Phoenix Automatic Sprinkler Heads –
Phoenix Alarm Valve –
Installed 1907
Water on System About 15 Mos –
Water Column of O Reading = 19 Feet –
Supervisory System –
Curve I = Test # I
Curve II = Test # II
I
II
LBS/SQ INCH –
GALLONS
0
20
40
60
80
100
120
140
80
160
240
320
400
480
560

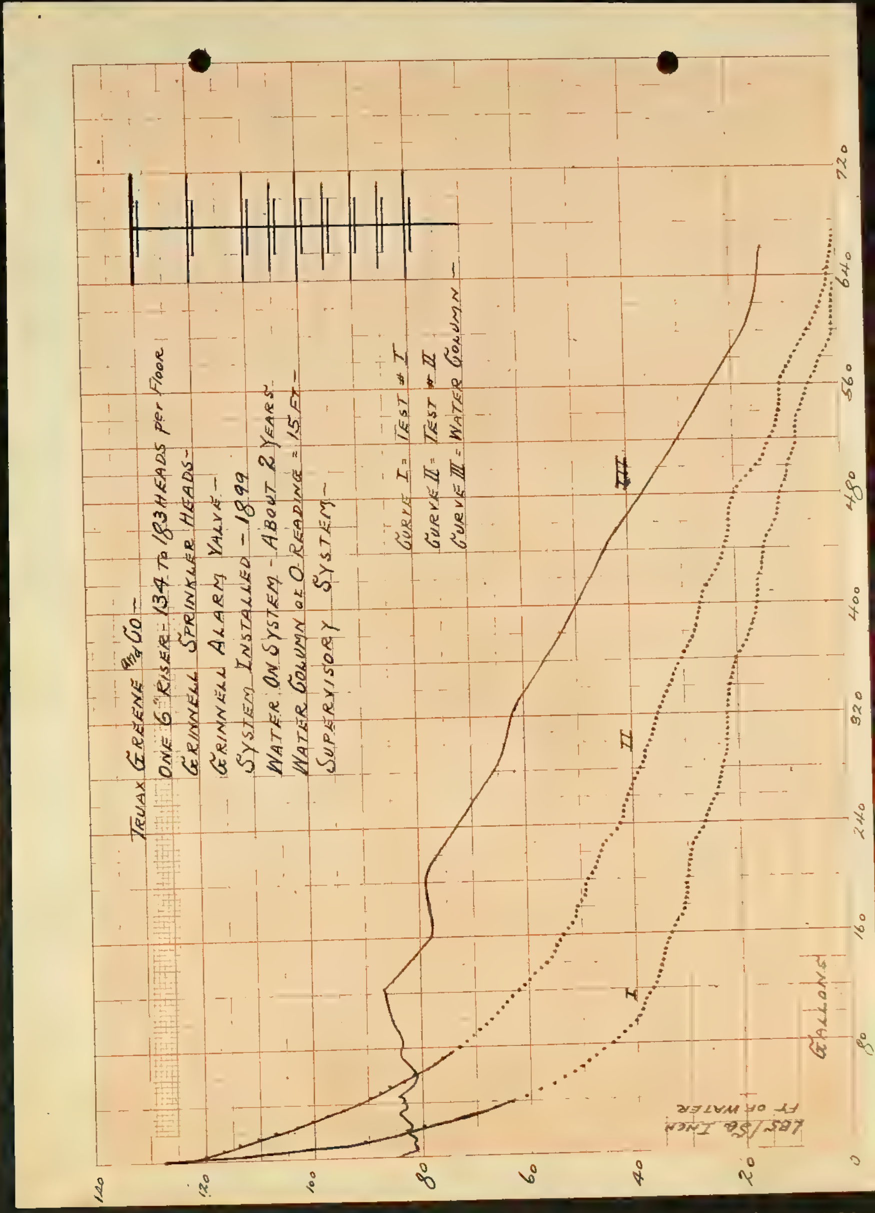

Chicago Mercantile Co. –
East Riser – 5" – 100 Heads Per Level
International Sprinkler Heads
Evans Alarm Valve –
System Installed – 1908 –
Water On System – 6 Mos. –
Water Column At O Reading = 2 Feet –
Supervisory System –
– Curve – Tests Nos. I & II –
Gallons
80
160
240
320
400
480
560
– Lbs/Sq. Inch
0
20
40
60


Underwriters' Laboratories
1-4" Riser – 40 to 80 Heads per Floor –
Sprinkler Heads – Various Types –
Grinnell Alarm Valve –
System Installed
Water On System – 3 Hours –
Water Column At O-Reading = 0 Ft –
No Supervisory System –
Curve No I = First Test
Curve No II = Water Column –
Gallons –
80
160
240
– Feet of Water –
– Lbs/Sq. Inch –
0
20
40
60
80
100
120
140


Marshall Field and Co –
Riser No 4 – 6"
Grinnell Sprinkler Heads
① Heads Pendant – 1 to 7
② Remaining Heads Upright –
Grinnell Alarm Valve –
System Installed – 1901-02
Water On System – About 2 Hrs –
Supervisory System –
13th
1st
Lbs/Sq. Inch –
Gallons –
0
20
40
60
80
100
120
140
160
180
160
320
480
640
800
960
1120


WILSON BROS —
NORTH WEST RISER — 4" — 70 HEADS/FLOOR —
INTERNATIONAL SPRINKLER HEADS —
GHRON VALVE — NO RETARDING FEATURE —
SYSTEM INSTALLED — 1902
WATER ON SYSTEM — ABOUT 18 MOS.
— CURVE = TESTS NO I and II.
LBS/SQ. INCH —
GALLONS
140
120
100
80
60
40
20
0
80
160
240
320
400
480
560


A.G. SPAULDING & BRO —
2 - 4" RISERS - 80 HEADS PER LEVEL —
GRINNELL SPRINKLER HEADS —
GRINNELL ALARM VALVE —
SYSTM INSTALLED - 1907 —
WATER ON SYSTEM - 2 YRS —
WATER COLUMN AT O-READING = 9.8 FT.
SUPERVISORY SYSTEM —
CURVE NO. I = FIRST TEST
CURVE NO. II = SECOND TEST
I
II
LBS. PER SQ. INCH —
GALLONS —
180
160
140
120
100
80
60
40
20
0
80
160
240
320
400
480
560


TRUAX GREENE and CO —
ONE 6" RISER - 134 TO 183 HEADS per Floor
GRINNELL SPRINKLER HEADS —
GRINNELL ALARM VALVE —
SYSTEM INSTALLED — 1899
WATER ON SYSTEM - ABOUT 2 YEARS —
WATER COLUMN at O READING = 15 FT. —
SUPERVISORY SYSTEM —
CURVE I = TEST # I
CURVE II = TEST # II
CURVE III = WATER COLUMN —
I
II
III
LBS/SQ. INCH
FT. OF WATER
GALLONS
120
100
80
60
40
20
0
80
160
240
320
400
480
560
640
720

A. C. McCLURG & CO. WEST RISER.

FIRST TEST. BOTTOM READINGS.

120
112
108
101
97
92
88
85
81
78
75
73
70.5
68
66
64.5
62.5
61
59
58
56.5
55
54
53
52.5
50.5
49.5
48
47
46
45
44.5
43.5
42.5
42
41.5
41
40.5
40
39
38.5
38
37.5
37
36
35.5
35
35
35
34.5

34
33.5
33
32.5
32
31.5
31.5
31
30.1
29.9
29.5
29.3
29
28.7
28.5
28.2
27.9
27.5
27.2
27
26.8
26.5
26.3
25.8
25.5
25
24.7
24.2
23.8
23.4
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22.7
22.2
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20.8
20.3
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19.8
19.7
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19.2
19.1
18.9
18.7
18.6
18.4
18.3

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18.1
17.9
17.8
17.7
17.6
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17.3
17.3
17.1
16.9
16.8
16.7
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16.4
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16.2
16
15.7
15.1
14.8
14.5
14.2
13.8
13.4
13.1
12.8
12.5
12.2
12
11.8
11.4
11.1
10.9
10.5
10.3
10.2
10.1
10.1
10
9.9
9.8
977
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2.1
2.1
2.1
2
2
2
1.9
1.7
1.4

1.1
.9
0.0
0.0
0.0
Suction.

A. C. McCLURG & CO. WEST RISER.

FIRST TEST. TOP READINGS.

95
90
84
79
74.5
70
66
63
59.5
57
54
51
49
46
45
42
40.5
38.5
37
35
34
32.5
31.5
30
29
28.5
27.5
25.5
25
25
23.5
23
22
21
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19
18.6
17.4
16.8
16.8
16.2
15.8
15.5
15.2
14.5
13.7
13.3
12.7
12.4
11.8
11.5

11.1
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10.6
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9.3
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7.1
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5.2
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4
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3.1
3
2.9
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1.7
1.4
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3.9
4.0
4.0
4.1
4.1
4.1
4.2
4.2
4.2
4.2
4.3
4.4
4.4
4.5
4.5
4.5
4.5
4.5

4.6
4.6
4.6
4.6

* All readings from star on are vacuum readings in pounds per square inch.

TRUAX, GREEN & CO.

SECOND TEST.

BOTTOM READINGS.

125.5
120.5
117
113
109
106
103
100
98
95
92
90
87
85
83
8105
80
78
77
75
73.5
72.5
71
70
69.5
68
67
66
65
63.5
62.5
61
60.5
60
59
58
57
57
56
55
55
54
53
52
52
51.5
51
51
50
50
50

48.5
48
48
47.5
47
46.5
46
45
45
44.5
44.5
43
42.5
42
42
41.7
41.5
40.8
40
40
39.8
39.5
39
38
38
37.5
37
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36.5
36
36
35.5
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35
34
34
33.5
32
32
32
32
31.5
30.5
30.5
29
29
29
28.7
28.5
28.2
27.8

27.3
26.7
26
25.4
25.3
25
24.7
24.3
24
23.5
23
22.5
22
21.4
21
20.8
20.7
20.5
20.3
20.2
20
19.7
19.0
18.5
18
17.3
16.8
16.2
15.8
15.3
14.8
14.2
13.5
13
12.5
12.2
12
12
11.8
11.7
11.5
11.2
10.5
10
9.3
8.8
8.1
7.7
7.5
7
6.5
6

6
5.5
5.1
4.7
4
3.7
3.2
2.6
2.4
2.3
2.2
2.1
2
1.9
1.5

TOP READINGS.

88.5	--	--	--
84.5	--	--	--
80.5	9	--	--
76	--	--	--
72	--	--	--
69.5	--	--	0
66	--	--	---
63	--	--	--
60.5	--	--	--
58	7.5	--	--
55.5	--	2	--
53	--	--	0
51	--	--	
49	--	--	
46.5	--	--	
45	--	--	
43	--	--	
41	--	--	
39.5	--	--	
38	7	1	
--	--	--	
--	--	--	
34.5	--	--	
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31	--	--	
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--	--	--	
28	5.5	--	
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--	--	--	
24.5	--	--	
--	--	--	
--	--	0	
22	--	---	
--	--	--	
--	--	--	
19.5	--	--	
--	--	--	
--	5	--	
17	--	--	
--	--	0	
--	--	--	
15	--	--	
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13	--	--	
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12	--	--	
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--	3	0	
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TRUAX, GREEN & CO.

FIRST TEST.

BOTTOM READINGS.

127.5
114.5
104.5
97
90
85
79
75
72
68
65
63
60
57
55
53.5
52
51
49
48
46.5
45
44.5
43
42.5
41.5
41
40.5
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38.5
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37.5
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31.5
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16.5
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16
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15.2
14.8
14.2
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6
5.5

5.1
4.8
4.3
4
3.6
3.2
2.8
2.4
2
2
2
1.9
1.8
1.7
1.6
1.4
1.2

WATER COLUMN
15 FEET.

TOP READINGS.

91
79.5
68.5
61
54.5
48
43
38.5
35
31.5
28.5
25.5
23
21
19
17
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6.22

*All readings from star on are vacuum readings in inches of mercury.

175
172
170
168
167
166
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60.5
60.5
60
59.5
59

A. G. SPALDING & CO.

FIRST TEST. BOTTOM READING. SECOND TEST.

167.5
143
124
110
97
90
83
77
72
68
64
60.5
57.5
55
52.5
50.5
48.2
47.5
45
44.7
43
42
41
40
39
38
38
37
36.5
35.5
34.5
34.5
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33.5
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32.5
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31.5
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30.2
29.8
29.5
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28.5
27.9

27.3
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15.3
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13.3
12.9
12.8

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10.2
9.9
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8.8
8.5
8.2
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7.6
7.3
7.2
6.5
6
5.5
5.2
4.7
4.3
3.9
3.6
3.4
3.2
3
2.8
2.5
2
1.5
1.4
1.2
0.9
.3
0.0

4.25 feet
head.

162.5
154
146
138
132
126.5
121
116
112
108
104
100.5
96.5
94
91.5
88.5
86
84
82
79.5
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63
62
60.5
60
58.5
58
56.5
56
54.5
54
53
51
50.5
50
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48.5
47.5
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46.5

45.5
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44.5
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43.5
43
42
41.5
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39.5
39.5
38.5
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37.5
37.5
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36.5
35.5
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34.5
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33.5
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32.5
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31.5
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24.5
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23.5
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22.5
22.5
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22

21
20.4
19.9
19.5
19.2
18.9
18.5
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17.3
16.8
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15.4
14.8
14.5
14.1
13.8
13.3
11.8
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11.2
10.6
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8.2
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7.8
7.5
7.3
7.1
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6.7
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5.5
5
4.7
4.5
4.3
4.1
3.9
3.8
3.5
3.2
3
2.9
2.6
2.3
2
2
1.8

1.5
1.3
1
.6
.2
0.0
Blowing.

A. C. McCLURG & CO. WEST RISER.

SECOND TEST. TOP READING.

98	20.5	6.4	2.3
94.5	19.7	---	2.2
91	19.3	6.4	2.1
87	18.8	---	2
84	18.3	6.5	1.9
80.5	17.7	6.4	1.9
78	17.4	6.2	1.9
74.5	17	6.1	1.8
71.5	16.5	5.9	1.8
69	16.2	5.7	1.8
66.5	15.5	5.4	1.8
64.5	15	5.2	1.7
62	14.7	---	1.7
60	14.4	---	1.7
58	14	4.9	1.8
56	13.6	4.8	1.9
54.5	13.3	4.7	---
52.5	12.9	4.5	1.7
51	12.6	---	1.6
49.5	12.3	4.3	1.5
48.5	11.9	4.1	1.4
46.5	11.6	4	1.3
45	11.3	3.9	1.3
44	11	3.9	1.2
42.5	10.9	---	1.1
41	10.6	3.8	1
40.5	10.3	3.7	1
39	10	3.6	1
38	9.8	3.6	.9
37	9.5	---	.9
36	9.2	3.5	.8
35	8.9	3.5	.7
34.5	8.7	3.4	.7
33.5	8.4	3.4	.6
32.5	8.2	3.3	.6
32	7.9	3.5	.6
31	7.8	3.5	.5
30	.75	3.5	.5
29	7.3	---	.5
28.5	7.2	3.4	.5
28	7	---	.4
27	6.9	3.4	.4
26	6.8	3.3	.4
25	6.8	3.1	.4
24.5	6.7	2.9	.3
24	6.8	2.9	.2
23	6.6	2.7	.2
22.5	6.5	2.6	.1
22	6.4	2.5	
21.5	6.3	2.4	

A. C. McCLURG & CO. WEST RISER.

SECOND TEST. BOTTOM READINGS.

121.5	44	25.7	14.2
117	43.5	25.3	14.1
113	43	25	14
110	42.5	24.8	13.9
107	42	24.4	13.8
103	41.5	24	13.5
100	41	23.7	13.3
98	40.5	23.4	12.9
95	40	23.2	12.5
92.5	39.5	23.1	12.1
90	39.5	22.9	11.9
87.5	38	22.7	11.6
85	38	22.5	11.2
82.5	38	22.4	10.9
80	38	22.3	10.5
79	37	22.1	9.9
77.5	37	21.9	9.4
76	36.5	21.8	9
75	36.5	21.7	8.5
72.5	36	21.5	8.5
71.5	35	21.3	8.4
70	35	21.2	8.3
68	34.5	21	8.2
67	34.5	20.7	8.1
65.5	34.5	20.5	8
65	33.5	20.2	8
64	33	19.9	7.9
62.5	32.5	19.7	7.7
61.5	32.5	19.3	7.4
60	32.5	19	7.2
60	32	18.7	7
58.5	31	18.4	6.5
57.5	30.5	18.1	6.2
56	30.1	17.8	5.8
55	30	17.4	5.4
54.5	29.8	17.1	5
54	29.5	16.9	4.5
53	29.2	16.4	4.3
53	29	16	3.9
52	28.8	15.7	3.4
51	28.5	15.3	3
50	28	15.2	2.8
48	27.8	15.1	2.3
48	27.5	15	2
47.5	27.2	14.9	1.7
47	26.9	14.7	1.5
45	26.6	14.6	1.3
45	26.2	14.6	1.2
44.5	26	14.5	.1
		14.3	.0.

ALBERT PICK & CO.

NORTH RISER. EAST SECTION. SECOND TEST.

BOTTOM READINGS.

121	22
112	21.3
105	20.5
98.5	19.8
93	19
87.5	18
82	17.3
78.5	16.4
74.5	16
71	15.1
68	14.8
65.5	14.6
63.5	14.2
61	13.9
58.5	13.6
57	12.9
55	11.8
53	11.1
51	10.2
50	10
48.5	9.8
47	9.5
45.5	9.3
44	9.2
43	9
42	8.6
40.5	8.2
39	7.6
38.5	6.7
37	5.7
36	4.8
35.5	4.2
35	4
34	3.9
33	3.7
32	3.5
32	3.3
31	3.1
29.8	2.8
28.8	2
27.9	
26.8	
25.8	
25.2	
24.7	
24.1	
23.8	
23.4	
22.8	

TOP READINGS.

92	9.3
85	9
78	8.8
72	8.7
67	8.5
62	8.4
57	8.2
53	8
49	7.9
46	7.6
43	7.4
40	7.2
37	6.8
35	6.5
33	6.3
31.5	6.2
30.1	6.1
28.5	6
26.9	5.9
25.3	5.7
24	5.4
23	5.1
22.1	4.9
21.2	4.7
20.5	4.5
19.8	4.3
19.1	4.1
18.7	3.9
18.1	3.9
17.8	3.8
17.4	3.8
16.8	3.4
16	3.1
15.3	3
14.7	2.9
14.1	2.7
13.7	2.5
13.3	2.2
13	
12.7	
12.5	
12.4	
12.3	
12	
11.5	
11	
10.7	
10.3	
9.8	
9.7	

WILSON BROS. NORTHWEST RISER.

BOTTOM READINGS.

FIRST TEST.

135.5
130
127
122
118
114.5
111
108
105.5
102.5
100
98
95
93
92
90
87.5
86.5
84
82.5
81
80
78.5
78
77
76
75
74
72.5
72
71
70.5
70
68
67.4
66
65
64
62.5
62
61
60
60
60
59
58.5
57
57
56

55
52.5
51
51
50.5
50
49.5
49
48.5
48
47.5
46.5
45
44
43
42.5
42
42
41.5
41.5
41
40.5
40.5
39.5
38
37.5
37
36
35
35
35
34.5
34
33.5
33
32.5
32
31.5
30.5
30
29
28.7
28.5
28.2
28
27.8
27.5
26.5
25.5

24.5
23.7
22.8
22.4
22.2
22
22
21.8
21.5
21.3
20.5
19.2
18
16.5
16.1
15.9
15.7
15.5
15.1
14.1
13
11.1
10
9.9
9.7
8.7
7.3
5.6
4
3.3
3.2
3
2.3

SECOND TEST.

135
130
126
122
117
112.5
110
107
105
102
98
96
93.5
92
90
88
86
85
83
82.5

Discontinued here.

WILSON BROS. SOUTHWEST RISER.

BOTTOM READINGS.

FIRST TEST.

NO SECOND TEST.

132.5
130
127
124
121.5
118
116
113.5
111.5
108.5
107.5
104.5
102
99.5
98
97
95.5
94
92
91
90
89
88.5
86.5
85
84.5
83.5
83
82
81
80
78.5
78
77
75
74
72.5
72
71.5
70.5
70
69.5
68.5
68
67.5
67.5
67

66
65
65
64
63.5
62
62
61
60
58.5
58.5
58
57
57
57
56.5
56
55.5
55
54
53.5
53
52
51.5
50.5
49.5
49
48.5
48
47.5
47
47
46.5
46
45.5
45
44
43
42.5
41.5
41
40.5
40.5
40
39.5
39.5
39

38
37.5
37
36.5
35
34
33.5
33.5
33
33
33
32.5
32.5
32.5
32.5
32
31.5
30.5
30
28
27
26.3
26.1
26
25.8
25.5
25.4
25.2
25
25
24.5
23.9
23
22.1
21.2
20.3
19.5
19.2
19.2
19
19
18.8
18.7
18.5
18
18
17.6
17

16.2
15.2
14.3
13.4
13
12.8
12.6
12
11.3
10.2
9.2
8
6.8
6.5
6.3
6
4.6
4.5

CHICAGO MERCANTILE CO.

EAST RISER. BOTTOM READINGS.

FIRST TEST.

125
119.5
114.5
109
105
101.5
97.5
93
91
88
85
82.5
80.5
78
76
75
73
70.5
70
68
66.5
65
64
63
61.5
61
60
58.5
58
57
56.8
56.4
55
54.8
52
52.5
52
51.2
50
48.5
47.8
47
46
45.2
45
45
44.2
43.8

43
42.7
42.4
42
41.7
41.5
40.8
39.5
38.5
38
37
37
36.7
36
35.5
35
35
35
34.6
33.8
33
32.4
31.8
30.4
29.8
28.5
28
27.7
27.4
27.1
27
26.6
26.4
26
25.6
25
24.2
23.5
22.7
21.8
20.9
20
19.6
19.6
19.4
19.1
19
19

18.8
18.4
17.8
17
16.3
15.5
14.8
13.9
13
12
11.5
11.3
11.2
11
10.9
10.7
10.5
9.4
8.8
8.
7.3
6.6
6.3
6.2
5.8
5.3
4.8
4.2
3.7
3
2.6
2 2
1.7
1.4
1.4
1.3
1.2
1.1
1
.8
.5
.0

SUCTION
WATER COLUMN
2 FEET.

SECOND TEST.

125
121
115.5
110
106
102
98.5
95.5
89
86
83.5
83.5
79.5
77
76
73
71.8
70
69
67.5
66.3
65
64
63
61.8
60.3
59.6
58.5
58
57
56
55
54.5
52.5
52
50.5
49.8
48.5
48
47
47
46.8
46
46
45
45
44.2
43.8
43

42.5
42
41
40
39
38
37.7
37.5
37.3
37.3
37
36.8
35.8
35.2
35
35
34.5
33
32.2
32
32
31
30
29.1
28.7
28.3
28.1
28
27.7
27.5
27.1
27
26.7
26
25.3
24.8
24
23.2
22.2
21.7
20.9
20.2
19.8
19.7
19.4
19.2
19.1
19
18.8

18.4
17.9
17.2
16.5
15.7
14.9
14.3
13.5
12.7
11.8
11.5
11.4
11.2
11
10.8
10.6
10.4
10
9.4
8.6
8.2
7.7
7.1
6.5
6.1
5.9
5.7
5.5
4.8
4.3
3.8
3.3
2.8
2.4
1.7
1.2
1
1
.8
.2
.0

SLIGHT BLOWING.

ALBERT PICK & CO.

NORTH RISER. EAST SECTION. FIRST TEST.

BOTTOM READINGS.

121	18.3
108	17.6
97	16.7
87.5	16
80.5	15.2
74	14.3
69	14.2
65	14
61	13.9
57	13.7
54	13
52	12.3
49	11.5
47	10.8
45	10
43	9.4
41.5	8.8
40	8
38	7.8
37.5	7.8
35.5	7.5
35	7.3
33.5	7.2
32.5	7.1
32	7
31.7	6.8
30.5	6
30	5.2
29.3	4.3
28.7	4
28	3.8
27.3	3.8
26.9	3.5
2622	3.3
25.7	3.2
25.1	3.1
24.5	3
24	2.5
23.3	1.7
22.8	Water column
21.9	7 feet.
21.2	
20.9	
20.4	
20.1	
20	
19.6	
19.1	

TOP READINGS.

85	0.0
81	0.0
70	0.0
62	0.0
55	0.0
49	0.0
44	0.0
39.5	0.0
35.5	0.0
32	0.0
29.5	0.0
27.2	0.0
24.5	0.0
23.5	0.0
20.6	0.0
18.7	0.0
17	0.0
15.5	0.0
14.1	0.0
12.8	0.0 *
11.6	.8
10.5	1.2
9.5	1.6
8.4	1.8
7.4	2
6.5	2.1
5.7	2
4.9	1.8
4.2	1.9
3.4	2.2
2.8	2.4
2.4	2.6
2	2.8
1.8	3
1.7	3.3
1.6	3.5
1.5	3.7
1.4	3.7
1.4	
1.3	
1.6	
1.7	
1.4	
1.2	
.8	
0.0	
0.0	
0.0	
0.0	

* All readings from star on are vacuum readings in inches of mercury,

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THOMPSON & TAYLOR.

EAST RISER. FIRST TEST.

BOTTOM READINGS.

122.5	9
111	8.8
101	8.3
92	7.7
86	7
81	6.4
76	5.8
72	5.1
68	4.3
65	4
63	1.9
60	1
57.5	.3
55	.1
52	0.0
50.5	Water column
47.5	2.5 feet.
46	
43	
42	
40	
38	
36.5	
35	
33	
32	
30	
28.6	
27.4	
26.1	
24.8	
23.6	
22.5	
21.4	
20.3	
19.3	
18.3	
17.3	
16.3	
15.4	
14.8	
14	
13.2	
12.4	
11.6	
10.9	
10.3	
9.8	

TOP READINGS.

79	1
67	.7
57.5	.3
49.5	0.0
45	0.0
39	0.0
35	0.0
32	0.0
29	0.0
26.5	0.0
25.5	0.0
24	0.0
22	0.0
19.5	0.0
18	
16.4	
15.2	
14	
13	
12	
11.1	
10.2	
9.4	
8.8	
8.1	
7.4	
6.9	
6.3	
5.9	
5.8	
5.1	
4.9	
4.5	
4.1	
3.9	
3.3	
3.1	
2.8	
2.6	
2.4	
2.1	
1.9	
1.8	
1.6	
1.4	
1.3	
1.2	
1.2	
1.1	

THOMPSON & TAYLOR.

EAST RISER. SECOND TEST.

BOTTOM READINGS.

121	9.1
111	8.5
102	7.9
95	7
88	6
82	5
78	3.5
74	2.3
70	1.9
67.5	1.3
65	0.0
61.5	
58	Water Column
55	3.5 feet.
53	
50.5	
48.5	
46	
44	
42.5	
40.5	
38	
37	
35	
33	
32	
30	
29	
27.5	
26.5	
25.3	
24	
23.1	
22	
21	
20	
18.9	
18	
17	
16.2	
15.6	
14.9	
14.2	
13.3	
12.7	
12.1	
11.4	
10.7	
10	
9.6	

TOP READINGS.

82	1.7
71	1.7
61	1.7
52	1.6
49	1.4
43	1.2
39.5	1.1
35	.8
32	.3
29	.1
27	
25	
23.2	
21	
19.8	
18.4	
17.1	
15.9	
14.9	
13.9	
13	
12	
11.2	
10.5	
9.9	
9.1	
8.6	
8	
7.6	
7.1	
6.7	
6.3	
5.8	
5.4	
5.2	
4.9	
4.5	
4.2	
4	
3.7	
3.4	
3.2	
3	
2.9	
2.7	
2.6	

2.3	
2.2	
2.1	
1.9	

MORRIS, MANN & REILLY.

BOTTOM READINGS.

FIRST TEST.

120
98
82
72.5
65
58
54
51
47.5
45
42.5
41
39.5
38.5
37.5
37
36
35.5
35
34
3355
33
32.5
32
31.7
31.5
31
30.3
29.7
29
28.3
27.9
27.3
26.9
26.3
26
25.5
25.1
24.8
24.4
24.2
24.1
24
23.9
23.8
23.7
23.5
23.3

23.2
23.1
22.9
22.4
21.7
21.3
20.9
20.4
20.2
19#7
19.3
19
18.6
18.3
18
17.6
17;4
17.3
17.3
17.2
17.2
17.1
17
16.9
16.7
16.3
15.8
15.3
15
14.5
14.2
13.7
13.3
12.9
12.5
12.2
11.5
11.2
11.1
11
11
10.9
10.6
9.9
9.3
8.7
8.1
7.5

6.8
6.4
6
5.6
5.3
4.9
4.9
4.8
4.7
4.7
4.7
4.7
4.6
4.6
4.6
4.5
4.5
4.5
4.4
4.3
4
3.3
2.9
2.4
1.8
1.4
1
.1
0.0

$ECOND TE$B

121.5
116
112
107.5
103
99
95
92
89
86.5
84.5
82
78.5
77
75
73
71.5
70
68
66.5
65
63.5
62
61.5
60.5
59.5
58.5
57
56.5
56
55.5
54.5
54
52.5
51.5
51
50
49.5
49
48
47.5
46.5
46
45.5
45
44.5
44
43.5
42.5

42
41.5
41
40.5
40.5
40
39.5
39
38.5
38.5
38
37.5
37
36
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33.5
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30.8
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A. C. McCLURG & CO. EAST RISER.

FIRST TEST. BOTTOM READINGS.

121
113
105.5
100
94.5
89
83.5
80.5
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74
70.5
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5.9
5.8

TEST NOT COMPLETED.